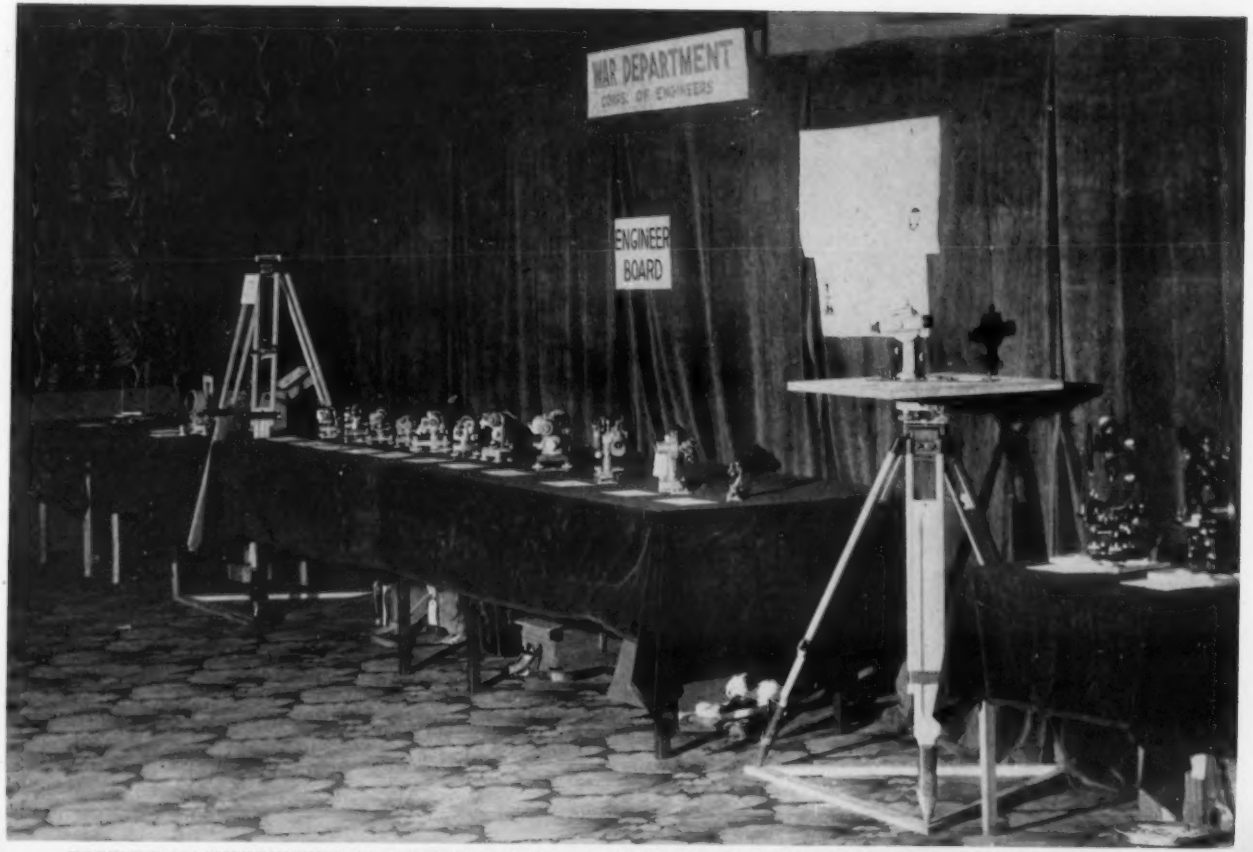
SURVEYING AND MAPPING

Aaron L. Shalowitz, *Editor*

A Quarterly Journal
Devoted to the Advancement of the Sciences
of Surveying and Mapping

Volume VI, No. 3
July–August–September, 1946

PUBLISHED BY THE
AMERICAN CONGRESS ON SURVEYING AND MAPPING
BOX 470, BENJAMIN FRANKLIN STATION, WASHINGTON 4, D. C.



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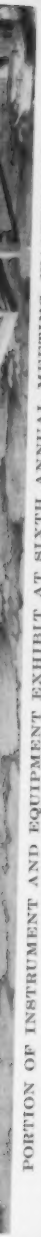

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SURVEYING AND MAPPING is published quarterly by the AMERICAN CONGRESS ON SURVEYING AND MAPPING, Box 470, Benjamin Franklin Station, Washington 4, D. C. SUBSCRIPTIONS: $3.00 a year to non-members; single copies, $1.00.

Entered as second-class matter at the Post Office at Washington, D. C., November 13, 1944, under the Act of March 3, 1879. Additional entry as second-class matter at the Post Office at Lancaster, Pa.

Opinions or assertions expressed in articles in this Journal do not necessarily represent the official views of the CONGRESS.

Government Responsibility in Surveying and Mapping

By CAPTAIN FRANK S. BORDEN
PRESIDENT, AMERICAN CONGRESS ON SURVEYING AND MAPPING

OUR PROGRAM says that the subject of this talk is "Government Responsibility in Surveying and Mapping." This is a pretty big order to cover in 15 minutes, so I propose only to discuss one phase of this broad subject, and I do it, on this occasion, only because, in endeavoring to make greater headway toward a realization of the objectives of our society, I find myself handicapped by what I consider to be a regrettable neglect on the part of the Federal Government in matters related to surveying and mapping.

This matter has been referred to as public relations; some even call it propaganda; but in its application to surveying and mapping problems and its contribution to their solution it is essentially a matter of the "dissemination of information." However, dissemination alone will not solve many surveying and mapping problems unless it is co-operative, well planned, and systematically and continuously carried on.

During my incumbency the past year considerable correspondence has come to my notice dealing with surveying and mapping problems on a federal, state, and local level. Much of this correspondence showed evidence of a groping in the dark, of a realization that something was wrong with our present mapping situation, and of an honest desire to find a solution to the difficulty. This same groping for a solution was in evidence at the Conference on Topographic Mapping Needs* convoked in June 1945—under the auspices of Region 2 of the Congress—for the purpose of exploring the possibilities of developing an integrated mapping program commensurate with federal and state requirements. In summary, two important conclusions can be drawn from the prepared statements and the discussions at that conference: first, that the federal mapping agencies seek and welcome the co-operation and advice of states, municipalities, and principal industries, in order that the federal mapping program can truly reflect the needs of the users of maps; and second, that some new approach is required to the problem of making the local engineer and surveyor, as well as others, cognizant of the benefits to be derived from the use of modern survey methods, co-ordinated survey data, etc. This is well illustrated by the following extracts from some of the statements that were made at the Conference. A delegate from one state said: "The progress of surveying and mapping in this country has lagged badly in the past through lack of local interest and local action." Another delegate said: "We have attempted in the past to interest state, county, municipal, and private engineers in the use of modern survey methods and to a large extent have failed."

In referring to the Pennsylvania Report,† one delegate said: "We thought it a good report; so did most of the engineers and map users who studied it. But

Presented at Sixth Annual Meeting, American Congress on Surveying and Mapping, Washington, D. C., June 28–29, 1946.

* A report of the Conference is contained in the July 1945 issue of SURVEYING AND MAPPING. The complete proceedings were published as a separate by the CONGRESS.

† Ibid., p. 12.

one legislator, leafing through the report, remarked with an incredulous expression that he could buy all of the topographic maps he wanted for 10 cents each and that for $138,000 (the recommended annual expenditure for topographic mapping), we should be able to buy several million at the wholesale rate."

It is clear enough that the Federal Government has certain responsibilities for surveying and mapping. Admiral Colbert this morning spoke of the community of interest that exists between the various federal mapping agencies in furthering the basic mapping programs of our country. A number of the states have likewise recognized this mutuality of interest among the various state agencies concerned with maps and surveys and have established state planning boards, or similar bodies, to co-ordinate the activities in the state. What is perhaps not so clear to many is that the mapping activities of the Federal and State Governments are inter-related and that the responsibilities of each require a close and continuous liaison with the other.

Obviously there is a wide gap between the federal and state mapping agencies, and it is just as obvious that it is the responsibility of the federal agencies to bridge that gap. The federal mapping agencies are public service organizations. Their purpose is to serve the interests of agriculture, commerce, engineering, mining, industry, and the public welfare. The data which they collect, whether processed in the form of maps and charts or in the form of special publications, manuals, or other forms, should be made readily available to the citizens of the country so that the maximum benefits will accrue to the taxpayers from the investment which they are helping to finance. The responsibilities of federal mapping agencies *should not end* with the mere production of a map or chart, or with the collection and publication of data, but should terminate only after such a product has been made available to those who might profit most through its use.

The majority of those seeking maps or map information neither know—nor appreciate—the widely divergent operational fields and functions of the map-making agencies and the specific purpose for which each type of map or chart is designed. Likewise, the surveyor, engineer, property owner, and others residing in localities situated a long way from Washington often have great difficulty in obtaining accurate surveying and mapping information because they do not know *what* information is available, *where* it may be found, or *how* to procure it.

The question now arises, "What is the best way to remedy this apparent weakness—to bridge this so-called gap?" I do not wish to appear presumptuous in undertaking to suggest to the Federal Government what its action should be, but as your President I believe it is entirely within the bounds of propriety for me to direct attention to certain desirable and appropriate action which, if carried out, would materially help in the attainment of several of the major objectives of this Congress.

I suggest then that in order to promote closer co-operation among the federal surveying and mapping agencies and to increase generally the service rendered by them to the public, there be established in the Federal Government an Interdepartmental Committee of Surveying and Mapping composed of one member each to be designated by the Secretaries of Agriculture, Commerce, Interior, War, and Navy. It would be the duty of this committee, working through sub-committees composed of members from the federal surveying and mapping agencies and in close co-operation with the surveying and mapping representative of the

Bureau of the Budget, to make detailed studies and recommendations regarding all phases of surveying and mapping, but it would devote itself primarily to planning co-operative dissemination of information, and to liaison with state, county, municipal, and private organizations engaged in surveying and mapping.

Among the manifold duties that this committee could perform would be to encourage the establishment of a surveying and mapping information office in either the capital of each state or the most logical city for maintaining statewide service. Organizations of this character would allow for the dissemination of available surveying and mapping data at the state level and could also be made to represent a co-ordinated plan for the entire country.

The State Planning Boards that have already been established represent much progress towards the development of the basic functions of such offices. Mr. F. A. Pitkin, the Executive Director of the Pennsylvania State Planning Board, reporting on the work in that State, had this to say: "By the time the war started the State Planning Board had assembled a large map collection. These maps, together with the air photographs and supporting statistical data, were invaluable. Army Engineers, consulting engineers, representatives of the public utility companies, and industrial engineers used these maps, photographs, and statistical data in selecting sites for cantonments, airports, munitions plants, war industries, and service facilities."

Through this type of a program one of the major deficiencies in the present mapping situation—the inadequacy in the dissemination of available map data—would be corrected.

Full dissemination of existing surveying and mapping information can best be provided for at the state level which, in turn, may be further decentralized to include regions or areas within the state as improved organization and experience permit. This type of approach to the problem requires a co-ordination of effort reflecting the resources of all federal mapping agencies. Our present methods of disseminating information and data from a central office or offices in Washington are apparently not adequate for meeting the multiplicity of mapping problems that arise at the local level. Public relations in mapping problems require more than just a great quantity of map material in Washington; they require the strategic placement over the country of representatives thoroughly familiar with the existing material and within easy reach of the map users. Counselors on the spot who can size up the situation and give out the correct information will solve much of the problem.

Mapping experts who represent all the federal mapping agencies and whose major interest and training are in surveying and mapping should be placed as liaison officers in the various state capitals or selected cities to provide first-hand information concerning mapping problems.

The map user should be able to get the aid he needs by applying directly to the surveying and mapping offices. These offices should, of course, be more than just storehouses of map knowledge. The public relations officer for mapping problems should concern himself with needed improvements in mapping work. The widest latitude for useful service lies in a close, co-operative kind of teamwork between the federal representatives, governments of the states, and technical societies including our own organization. Only through this sort of widespread co-operative effort can the most good be accomplished in extending and developing surveying and mapping.

The Sixth Annual Meeting

EDITOR'S NOTE.—Since most of the technical papers presented at the Sixth Annual Meeting appear in this issue of the Journal, only so much of the proceedings are being reported as are not reflected in the papers.

THE SIXTH ANNUAL MEETING of the American Congress on Surveying and Mapping was held at Washington, D. C., on June 28 and 29, 1946, in the Congressional Room of the Hotel Statler. It was the first postwar annual meeting of the Congress and was attended by 475 persons—the largest group ever to attend—representing all parts of the country as well as visitors from Canada, Australia, Colombia, Mexico, and Peru. This was a gratifying manifestation of interest in the work of the Congress and augurs well for the future of the organization. The meeting was opened by President Borden. He introduced Rear Admiral Leo Otis Colbert, Director of the U. S. Coast and Geodetic Survey, who made the welcoming address. (Admiral Colbert's remarks appeared in the April–June issue of SURVEYING AND MAPPING.)

GENERAL SESSIONS

The technical papers presented during the general sessions included discussions on the use and application of electronics to the various branches of surveying and mapping; postwar opportunities, education, and technical standards for surveyors; engineering surveys in urban areas and for highway planning; developments in instruments and cartographic methods; and co-ordination and administration of surveying and mapping activities.

The first morning session was presided over by Professor Philip Kissam of Princeton University. The following papers were presented: "Wartime Developments in Electronics," by Professor Robert R. Brown of North Carolina State University; "Shoran Investigations for Triangulation Control," by Lt. Col. C. I. Aslakson, U. S. Army; "The Use of Shoran in Hydrographic Surveying," by Lt. Comdr. C. A. Burmister, U. S. Coast and Geodetic Survey (read by Lt. Comdr. E. B. Roberts, also of the Survey); "Electronic Aids to Marine Navigation and Surveying," by Mr. Thomas J. Hickley, U. S. Coast and Geodetic Survey (read by Mr. C. M. Jansky, Jr., Consulting Radio Engineer); and "Where Do We Go from Here?" by Mr. Gerald FitzGerald, U. S. Geological Survey.

The first afternoon session was presided over by Professor G. Brooks Earnest of Case School of Applied Science. Talks were given on the following subjects: "Postwar Opportunities in Private Practice," by Mr. S. A. Bauer, practicing surveyor of Cleveland; "Standard Specifications for Private Practice Surveyors," by Mr. William C. Wattles, Title Insurance and Trust Company, Los Angeles; "Programming Urban Surveys," by Mr. Murray Y. Poling, U. S. Coast and Geodetic Survey; and "Large-Scale Mapping by Photogrammetric Methods," by Mr. Virgil Kauffman, Aero Service Corporation, Philadelphia.

At the second morning session the following papers were presented: "Engineering Education in the Americas," by Dr. S. S. Steinberg, University of Maryland; "A New Era in Surveying and Mapping Curricula," by Professor George H. Harding, Ohio State University; "Developments in Surveying Instruments," by Mr. Charles R. Manor, Engineer Board, Corps of Engineers; and "Developments in Cartographic and Reproduction Methods," by Mr. Gordon B. Little-

page, U. S. Coast and Geodetic Survey. The session was presided over by Dr. John K. Wright, Director, American Geographical Society.

At the second afternoon and final session of the meeting, Commissioner Thomas H. MacDonald of the U. S. Public Roads Administration presided. Papers were presented on the following subjects: "Engineering Surveys in Highway Planning and Construction," by Mr. Wilson T. Ballard, Maryland State Roads Commission, and by Mr. R. Getty Browning, North Carolina State Highway and Public Roads Commission; "The Map Information Office of the U. S. Geological Survey," by Mr. C. F. Fuechsel, U. S. Geological Survey; "The Co-ordination and Administration of City Surveying and Mapping Activities," by Mr. Joseph M. Dearborn, Director, Bridgeport Geodetic Survey; and "Co-ordinating and Administering Federal Surveying and Mapping Activities," by Mr. Robert H. Randall, Bureau of the Budget.

Business Session

The business session was held on the evening of the first day and was opened by President Borden. Approximately 100 members were present. President Borden announced that owing to the mounting work of the organization, the Executive Committee relieved Major Evans of the duties of Acting Secretary and appointed Mr. Walter S. Dix of the Tennessee Valley Authority to fill that office. Major Evans still retains the office of Treasurer. It was also announced that the resignations of Vice Presidents Rayner, Saunders, and McArthur of Regions 4, 8, and 9, respectively, had been regretfully accepted. These vacancies will not be filled pending revision of the Constitution and By-Laws which are now under study by a committee headed by Mr. Helmuth Bay of Rand, McNally and Co.

President Borden then called on Mr. Marshall S. Wright, Vice President of Region 2, to preside for the balance of the session. Mr. Wright told of his attendance at the Annual Meeting of the Corporation of Land Surveyors in Quebec during April 1946. He described the comprehensive study requirements set up by Laval University for degrees in surveying and forestry engineering. This, he said, probably accounts for the high esteem in which a surveyor is held in Canada.

Major Richard T. Evans, Acting Executive Secretary and Treasurer reported on the present status of membership and on other matters. He submitted a financial statement of the Congress which was approved by the members. (Both reports were published in the April–June issue of Surveying and Mapping.)

Reports were received from Mr. Murray Y. Poling, Chairman, Membership Committee; Mr. Joseph M. Dearborn, Chairman, Interim Committee on Municipal and County Engineering Surveys; Mr. S. A. Bauer, Chairman, Technical Division on Property Surveys; Captain C. L. Garner, Chairman, Technical Division on Control Surveys; Mr. John G. Staack, Chairman, Technical Division on Topographic Mapping; Mr. Daniel Kennedy, Chairman, Washington Local Section; and Mr. A. L. Shalowitz, Editor, Surveying and Mapping.

Mr. Bauer moved the adoption, in principle, of the Technical Standards proposed by the Property Surveys Division and previously distributed to the membership, subject to such changes of detail as are felt advisable to be made in line with suggestions received. The motion was carried. The approved Standards are published elsewhere in this issue.

Mr. Staack presented a motion for the consolidation of the Technical Divisions on Photogrammetric Mapping and Topographic Mapping into a Division on

Topographic Surveying and Mapping. It was stated that this motion had the approval of the Chairman of the Division on Photogrammetric Mapping. The motion was adopted. Mr. Staack remains as Chairman of the consolidated Division.

Mr. Wright presented a resolution to the Congress endorsing the establishment within the framework of the United Nations of a cartographic staff unit and an international co-ordinating agency. The resolution, which was adopted without dissent, is published elsewhere in this issue.

The report of the Tellers Committee indicated that President Borden received 313 of the 317 letter ballots received by the Secretary. Captain Borden was accordingly declared re-elected President of the Congress for the ensuing year. President Borden expressed gratitude for the confidence placed in him by the membership, and expressed the hope that the coming year would see an intensification of the activities of the Congress. President Borden then delivered a prepared address on "Government Responsibility in Surveying and Mapping," after which the meeting was adjourned.

Evening Dinner

The Sixth Annual Meeting was climaxed with an informal dinner and program of entertainment in the Congressional Room of the Hotel Statler. A technicolor movie of Costa Rica, interpreted by Mr. Luis Marden of the National Geographic foreign staff, was enthusiastically received by the 200 members and guests. "The Melodaires," a colored male quartet, rendered a number of spirituals and other selections, and Captain C. C. Slayton, U. S. Navy (retired), performed a series of "postwar magics."

The Sixth Annual Meeting was brought to a close by President Borden who thanked Mr. Poling and his Committee for arranging such an outstanding event.

Instrument Exhibit

A feature of this year's meeting was the exhibit of instruments and other surveying equipment, participated in by the following sponsors: Abrams Instrument Corporation; Aero Service Corporation; C. L. Berger & Sons, Inc.; Fairchild Camera & Instrument Corporation; W. & L. E. Gurley; Keuffel & Esser Company; Wallace & Tiernan Products, Inc.; David White Company; Wild-Heerbrugg (H. F. Ritz, General Agent); and The Engineer Board, Corps of Engineers, U. S. Army.

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2000 Members—1947 Goal!

We now have 1200 members in good standing. If every member would enroll one of his professional associates in the Congress, our goal would be reached with very little effort and without fanfare. It is as easy as that!

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A New Era in Surveying and Mapping Curricula

A Challenge and an Opportunity

By GEORGE H. HARDING*

IT OFTEN has been stated that the newspapers of this country print for the most part what their subscribers wish to read. In a similar manner, the educational institutions, reacting much more slowly, present courses and subject matter which their customers, both students and employers of graduates, demand. On occasion these educational institutions, pioneering with new developments scarcely past the laboratory stage and sensing the future needs of both students and employers, will take the lead in making these developments available through courses prior to the creation of a public demand.

This paper is directed at a situation which presently exists in which the traditional leadership of educational institutions is lacking. I shall present a few ideas on the contributing causes to this situation, and also a few suggestions which constitute a challenge to engineering education. I trust that in some small way these remarks will assist in stimulating a realization of the problem as well as the opportunity which exists for engineering education to become a real factor in what is now a proven science.

Shortcomings in Engineering Education

Knowledge and the ability to think and use that knowledge are the prime purposes of all education. Education may be acquired by formal courses presented in our educational institutions, by reading and self-teaching, by experience, or by any combination of these means. In this particular instance the development of photogrammetry and precise surveying has been accomplished generally in spite of, rather than with the help of, our many engineering educational institutions.

There is no corresponding example in the entire field of engineering education where actual practice has so far outstripped the instructional phase as in the case of mapping with its attendant control surveys. There are, as is the case with most generalizations, a few outstanding exceptions to this statement, but they are all too few.

The traditional conservatism of the engineer apparently has been carried to the extreme in the civil engineering departments of the colleges and universities of our country. Present procedures as practiced in our principal map-making agencies are ignored, either because of the traditional lack of interest by most engineering faculties in surveying and mapping, ignorance of the developments in these fields, or both.

Administrators in engineering education in the United States are fast approaching the point at which they will be forced to make certain decisions and take definite actions with regard to the surveying and mapping portions of their

Presented at Sixth Annual Meeting, American Congress on Surveying and Mapping, Washington, D. C., June 28–29, 1946.

* Research Professor of Civil Engineering, Ohio State University.

educational programs. These decisions and actions are long overdue. Upon these decisions and actions will depend the future position of these universities and colleges in the educational field with reference to these and related subjects.

Let us examine for a moment the attitude just referred to as "the traditional lack of interest by most engineering faculties in surveying and mapping." We all know and admit that the attitude is general, but what we should be interested in is the cause for that attitude, and the manner in which it might be corrected.

Traditionally, surveying and mapping are usually a part of the civil engineering curriculum of our engineering educational institutions, and were perhaps the earliest expressions of engineering skill. Since the time when man as an individual first claimed certain land as his own, boundaries have been an important item in our economic and social structure. Boundaries between tribes, and later nations, were determined by war, treaties, or both. Maps became essential when men developed intensively the land to which they held title. Maps also permitted them to travel over the land and navigate the seas, and to these now has been added navigation by air. So, man has long been accustomed to maps and charts of a sort. Perhaps this assumed familiarity has bred contempt.

Surveying and mapping for many centuries advanced slowly, but all the while the desirability for accuracy was recognized. Gradually, contributions were made which brought surveying out of the compass, and mapping out of the rough-sketch, stage. Finally we reached, some years ago, the era of the transit, level, and plane-table. For some unknown reason this apparently was accepted as the zenith of the surveying and mapping developments. For 40 or 50 years developments and improvements to equipment and procedures were relatively unimportant, certainly not revolutionary. The surveying courses which were taught to our grandfathers and fathers are essentially the same as are taught in the majority of our engineering schools today and, in many instances, I do not doubt that the same equipment is still used.

The courses became stereotyped and standardized and consisted, for the most part, of applied trigonometry plus instrumentation. So "dry rot" set in and the more ambitious members of civil engineering faculties, looking for new fields to conquer, turned to structures, hydraulics, water supply, sewage disposal, and many other fields in which the apparent ultimate had not been reached.

This lack of interest in surveying and mapping is attributable to three distinct attitudes on the part of the teaching profession. These attitudes have been carried over also into the older professional societies.

First, there is the distaste for field work. Due to limitations of curricula, teaching personnel, and suitable places to conduct the field work connected with surveying and mapping courses, there is, over the country as a whole, quite a conglomeration of solutions to this problem. This results in some instances in surveying instruction being conducted on the campus under extremes of weather conditions and, due to the small size of some campuses, this activity, by necessity, takes upon itself a merry-go-round quality. It has been the attitude in many instances that, since surveying and mapping field work involved this outdoor exposure to the elements, the teaching of courses of this type should be delegated to the newer and younger members of the staff, enabling the higher ranking members of the faculty to conduct other courses of such a nature that professional dignity could be more readily maintained.

The second is the attitude that mental activity required in the solution of

problems is stereotyped to a large extent. It is doubtful if clear, logical, and orderly thinking is required to any greater degree in any other courses of the curriculum than is required in thorough, comprehensive courses in both photogrammetry and precise surveying, with their attendant mathematical bases.

Finally, there is the generally prevalent attitude that, in order to achieve success or prominence, the teaching of subjects having some mysterious aura of professional respectability is always preferred to those involving surveying and mapping. Surveying and mapping courses have for years occupied the unhappy "step-child" relationship to the rest of the family of courses included in the normal curriculum. The reasons for this may be due to quite a number of different contributing causes: first, the fact that in years gone by and up to the present time, surveying was and is practiced as a trade by individuals with background limited to practical experience; and second, that the dividing line between the professional white collar worker and the field man—in field surveying—was rather uncertain, if it existed at all.

Then, too, in the early days the low value of land did not warrant expenditures for surveys of high accuracy, with the possible exception of those made by our Federal Government. This led, through the years, to the development of two groups of people undertaking the problems of surveying and mapping from entirely different viewpoints: one with precision paramount, compatible with the equipment and procedures available; the other with precision relegated to a less important consideration and, guided by economic considerations, with results of varying accuracy, dependent upon property values and land-use. For many years there was no attempt to correlate these two entirely separate lines of thought, and in fact in many sections of our country today, this dual viewpoint still obtains.

In Europe, however, where concentrations of population made land-use important, research went on. But here in the United States only a few hardy pioneers dared to insist that there must be a better and more accurate way of producing maps economically. World War I, with its attendant development of the airplane and aerial cameras, gave impetus in Europe to the use of photographs taken from the air. This suggested the possibilities which, although followed up at once by some of the European nations through subsidies, were ignored for some time here in the United States. Again, there were exceptions to this general attitude but, for the most part, the educational institutions wrapped their robes of complacency about them; and, if they were not content with existing equipment and procedures, at least they made no real effort to overcome the technical problems or to contribute to the development.

Certain few commercial, educational, and governmental organizations which included among their staffs individuals who believed improvements could and should be made, kept alive the small spark of interest on this continent. Gradually, with the improvement of cameras, film, planes, and stereoscopic equipment, the principal map-making agencies of the Federal Government accepted and began to utilize photogrammetric processes for the production of maps. With this expansion of photogrammetric mapping over large areas, accurate control surveys were necessary to produce accurate maps. Today we have a situation where the informed realize that both mapping and control surveys are subject to still further radical changes which may even revolutionize the present new mapping procedures.

Electronics has just begun to enter the mapping field. Photogrammetry is still developing. The combination of future developments in both these fields may result, sooner than many may realize, in still more accurate maps, produced in less time and at a fraction of the cost of present-day methods.

Photogrammetry is not new to the profession. Precise surveying, which provides the essential control for photogrammetry, is not new to those who have been using it for some decades. Up to the present time the development of photogrammetry and precise control surveys have been interdependent and must continue that way until such time as future developments might change that relationship.

Precise surveys, in addition to being essential to accurate photogrammetric maps, have many other practical applications. In many states we now have adopted State Plane Coordinate Systems to enable all surveys made within the state to use these systems as a means of checking and strengthening their own surveys. Yet, if we are entirely frank, we shall have to admit that not 10 percent of the registered surveyors, in the states which have adopted State Plane Coordinate Systems, understand the fundamentals involved in these systems well enough to use them. And equally important, the majority of graduating civil engineering classes in this and recent years, are, for the most part, no better prepared.

A Need for Trained Men

The mapping agencies of this and other governments of the western hemisphere need trained men. These trained men are not presently available from our engineering schools. No one could imagine a recent electrical engineering graduate without a fundamental knowledge of radio, or a young mechanical engineer without the fundamental knowledge of Diesel engines. Yet, today, we accept, complacently or not as the case may be, civil engineering graduates without a basic knowledge of the fundamentals of photogrammetry and precise surveying.

To what extent can engineering educational institutions take their share of this development and help to meet these existing needs? The first thing that most of them should do is to bring their present courses in surveying and mapping up to date. They owe that obligation to their students, their graduates, and their own established reputations. Every institution is dependent entirely or in part on public or private funds, in addition to tuition fees. No institution is satisfyng its obligation to those who support it, if it permits men to graduate in any field without a knowledge of the basic fundamentals of procedures and equipment in current use in that field.

I recently had occasion to make a trip, contacting various governmental mapping agencies and certain educational institutions both here in the United States and in Canada. Here are some of the observations made to me:

(*a*) One large governmental organization, having need of men for precise control surveys, stated that they were hiring non-engineers who had specialized in mathematics because, since they had to train them anyway, it was easier for them to give instrumentation instruction than it was to give the mathematical background, in which *most engineering graduates were not too proficient.*

(*b*) One of our outstanding instrument companies was seriously considering giving courses at its plant in the use and handling of new, modern equipment.

(*c*) Jobs are available and going begging, at good salaries even for these times, for persons adequately trained in both precise surveying and photogrammetry and competent to organize and conduct large mapping programs and to train additional employees.

(*d*) Faculties of engineering schools are in need of experienced men as instructors in both photogrammetric and precise surveying fields.

As precise surveying comes more and more into common use, it ceases to lay claim to the Coast and Geodetic Survey and other mapping agencies as its sole users. State, county, and municipal engineers and surveyors are beginning to realize that here is another tool of their profession. Photogrammetry is no longer used solely by the governmental agencies who developed it, but is being accepted by state, county, and municipal agencies for all sorts of operations. Each new user of photogrammetry and precise surveying widens still further the field, develops the possibility of new applications, and further increases the demand for trained personnel.

Recommendations for Curricula Changes

To simplify the presentation of suggestions regarding the surveying and mapping curricula, the following questions and answers are proposed. The answers, in your opinion, may be debatable and, if so, so much the better, for by debating them you are forced to think of alternatives.

1. What should be done with the present surveying and mapping courses in our curricula?

All surveying and mapping courses should be thoroughly examined as to content, procedures, and equipment used, with the idea in mind of modernizing wherever possible. We should eliminate procedures that have been superseded unless they are presented as background and for historical interest. The emphasis should be on those portions which are applicable to present-day conditions. Once having done this, we must keep the entire group of surveying and mapping courses up to date by periodic revision. We must bring the surveying equipment up to date by adding more modern and precise instruments. Suggestions for improving instruments should be sent to the manufacturer so that he knows what improvements are needed.

2. What might be considered a minimum requirement for a basic course in photogrammetry to include fundamentals only?

I would recommend two courses, although, depending upon the length of course and number of hours, it might be combined into one. (a) The first would deal primarily with aerial photography and would include a study of mapping cameras, camera mountings, lens distortions, focal length of lenses, mapping film, paper, enlargements and reductions, scale of photographs, tip and tilt of photographs; the preparation of controlled and uncontrolled mosaics; the use of graphical and template methods of supplementing control; the use of photographs for engineering purposes, including tax maps, for reconnaissance surveys for roads, railroads, and power lines, for water power and resources, for flood control, subdivisions, etc.; and the use of simple mirror stereoscopes for examining air photographs, with or without magnification, and the preparation of planimetric maps. (b) The second course might include the simpler photogrammetric instruments, the plotting of precise control, and the preparation of a simple topographic sheet made with the less expensive photogrammetric equipment; an explanation of the principles of the more complex and costly photogrammetric equipment, illustrated by photographs and diagrams; and an inspection trip to one of the governmental

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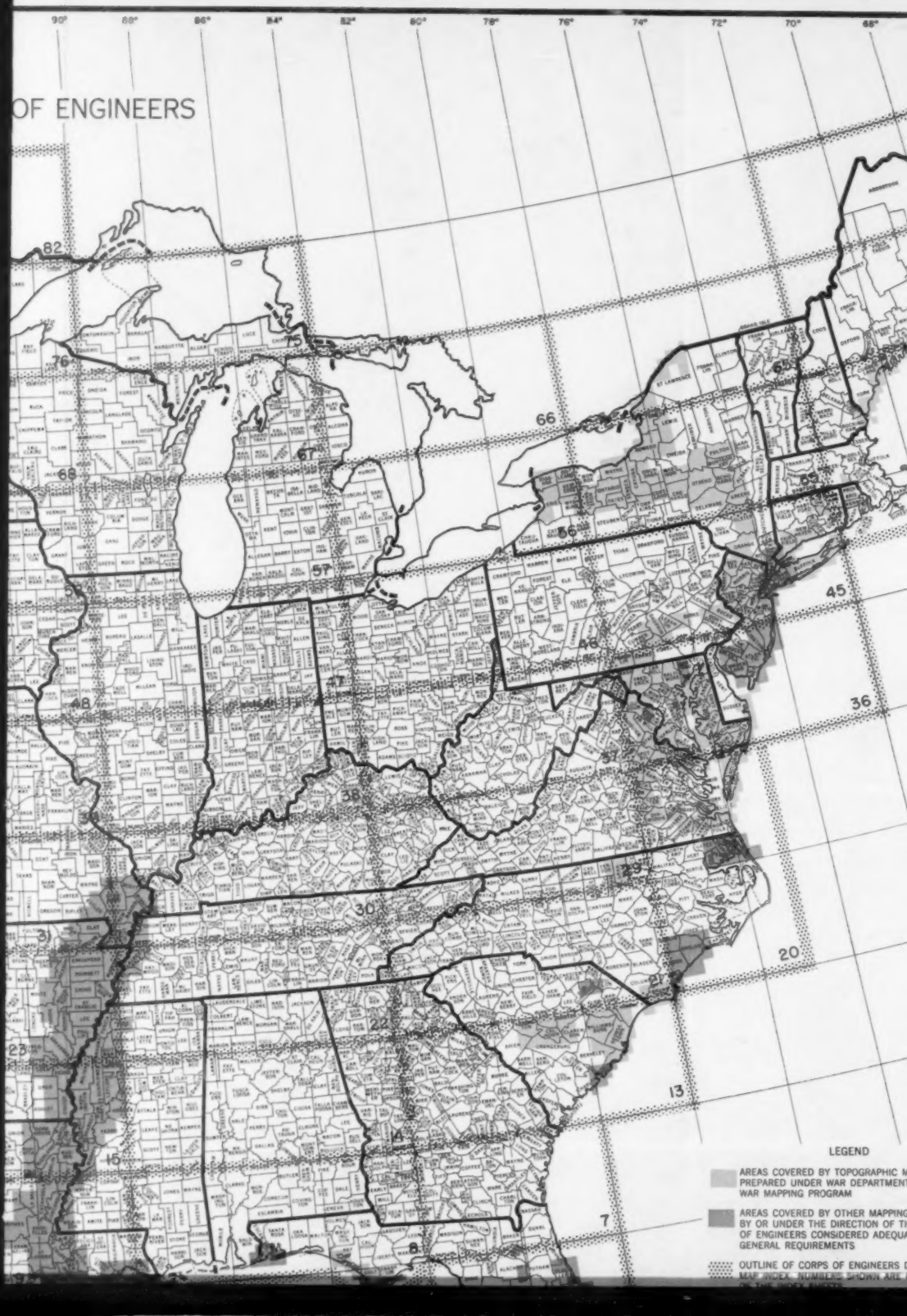
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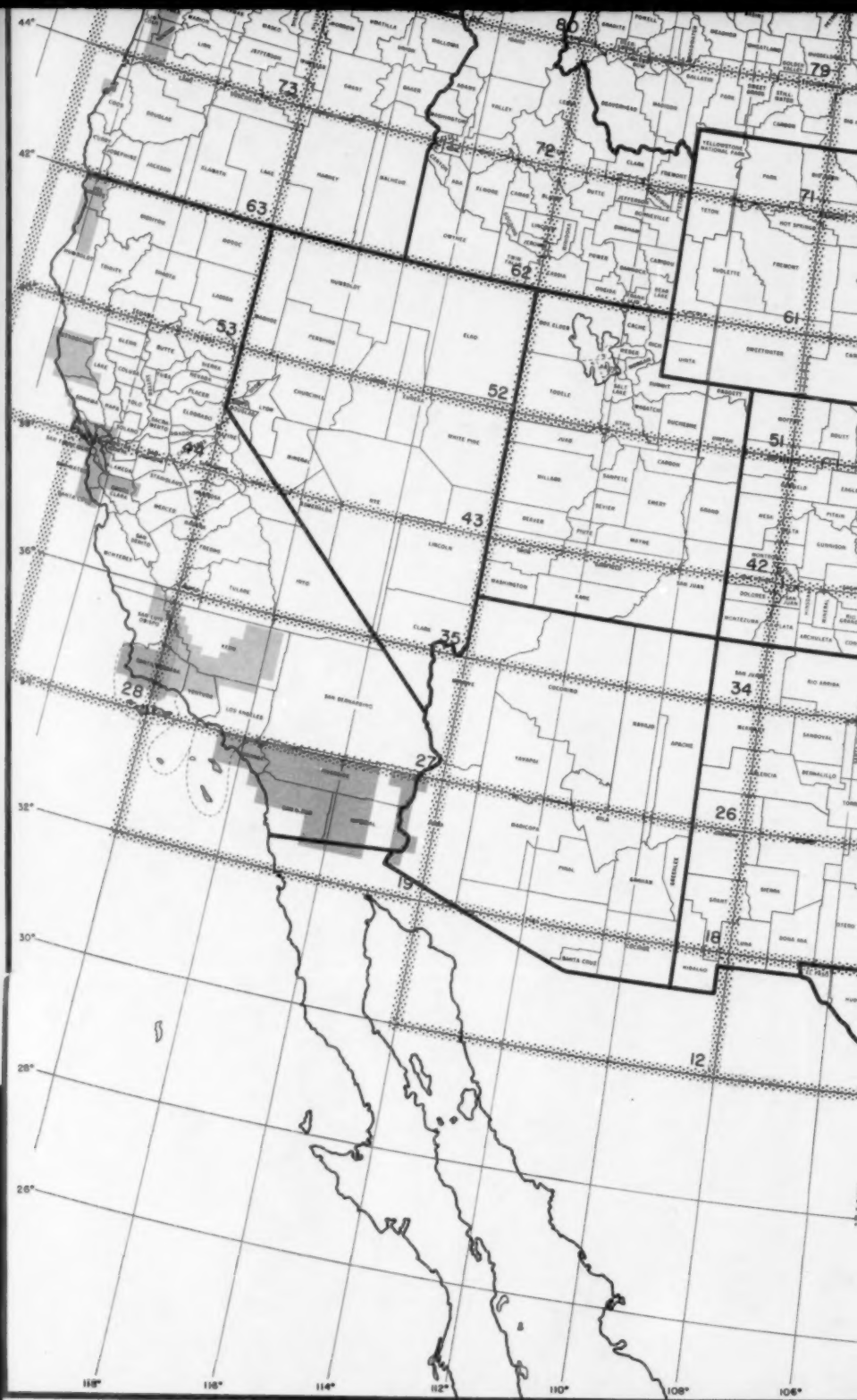
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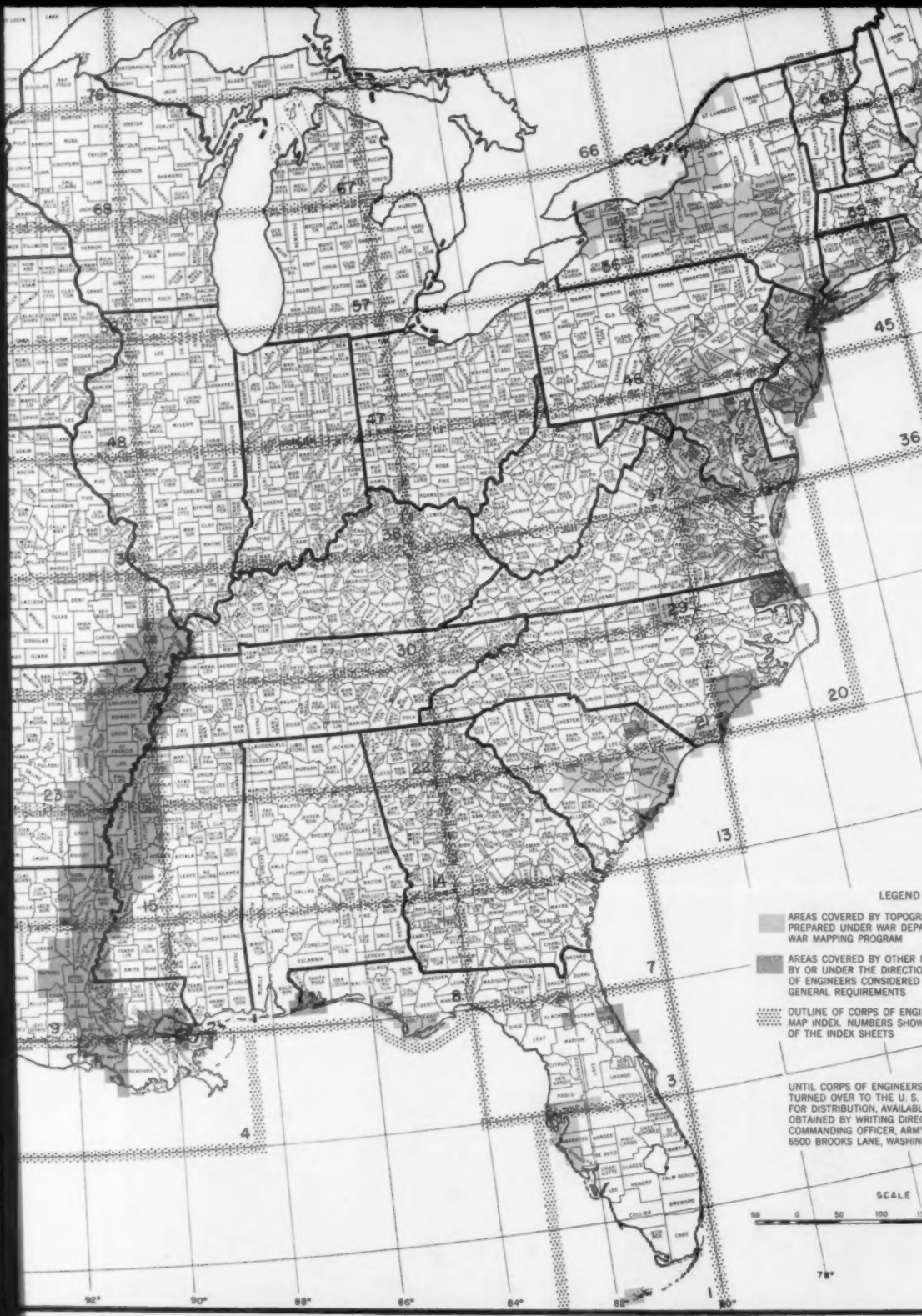
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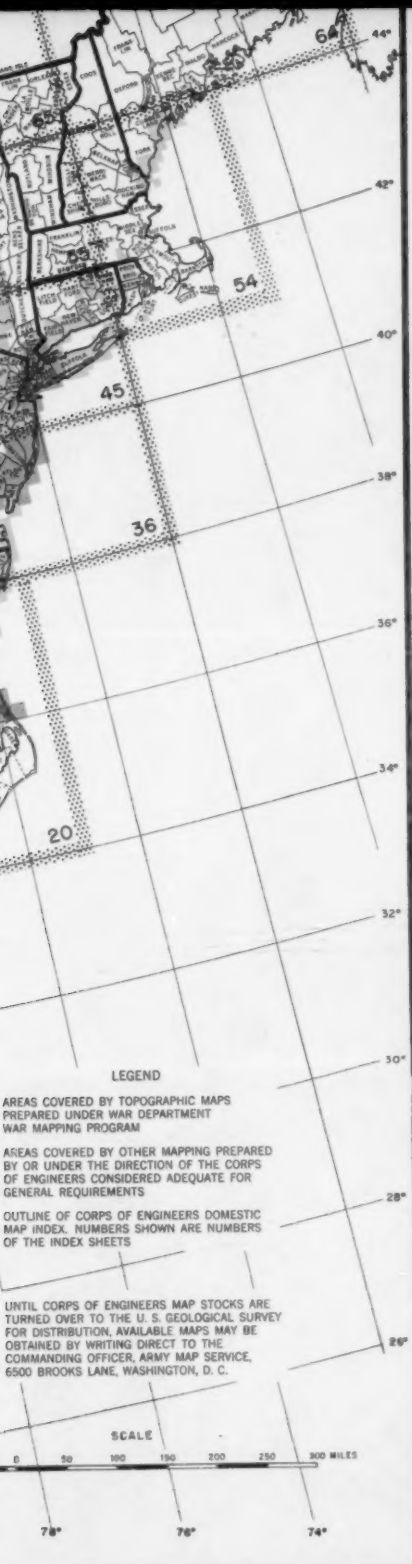

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mapping agencies using the latest photogrammetric equipment, wherever this is possible.

3. What might be considered a minimum requirement for a course in precise surveying to include the basic fundamentals?

Such a course should include thorough and practical instruction in least squares; a working knowledge of coordinates as provided for by the state-wide coordinate systems; a basic knowledge of what might be termed surveying astronomy to familiarize the students with the heavenly bodies which are generally utilized in the determination of latitude, longitude, true north, and time; and a familiarization and practice course with the actual use of precision instruments including theodolites, tilting levels, and precise taping equipment. I would recommend that this subject be divided into two courses, but this is again dependent upon the length of course and hours available.

4. Are these recommended courses of graduate or undergraduate caliber?

The recommended courses are *undergraduate and basic.* It is not recommended that institutions attempt to give graduate work in either the fields of photogrammetry or precise surveying unless they have the financial resources and trained personnel to include the latest equipment, which, ordinarily, is too expensive to justify the demand at any one institution. Basic fundamentals should be taught, giving the student a solid foundation and understanding upon which to add specialization should the occasion arise.

5. How can the faculty member keep up with the latest developments in surveying and mapping?

Every faculty member concerned with the teaching of surveying and mapping should affiliate himself with those national organizations that are concerned with their development. He probably belongs to the Society for the Promotion of Engineering Education, due to the fact that he is in the teaching profession; he may be a member of the American Society of Civil Engineers; he should also, from the standpoint of his interest and responsibility in teaching surveying and mapping subjects, become a member of both the American Congress on Surveying and Mapping and the American Society of Photogrammetry. He should read carefully both of the publications of these organizations. He should make every attempt to attend conferences and meetings on surveying and mapping whenever this is possible, and should visit the plants of our governmental map-producing agencies as well as our outstanding commercial organizations doing this work.

6. What can be done for the practicing engineer, surveyor, and graduate of some years back who is not familiar with photogrammetry or precise surveying?

This constitutes a national problem and one which I believe can be solved only by real co-operation. I suggest that the organizations I have just mentioned, co-sponsor an annual surveying and mapping conference in each of our states, in co-operation with the engineering schools, governmental agencies, and commercial concerns of the state, and with the federal mapping agencies. These annual conferences of 1 or 2 days' duration should be designed for the purpose of acquainting state, county, municipal, and private surveyors and engineers with the developments in surveying and mapping as well as providing for an inter-

change of technical knowledge. Second, I suggest that regional conferences, including groups of states, be co-sponsored by the same national organizations and held every 2 or 3 years in each region. These sponsored state and regional meetings, combined with the annual meetings of each of the sponsoring organizations, should go far in assisting the men already in the profession who can use photogrammetry and precise surveying, but who have had no formal education in these fields.

Spanish Should be Added

The development of natural resources in this hemisphere as well as elsewhere, due to the economic liabilities imposed on the various nations as a result of the war, has become of prime importance to the survival and continued well-being of any nation. The intelligent development of natural resources can be accomplished economically only when adequate maps are available of the area concerned, for the purpose of study and preliminary planning. Speaking just of this hemisphere alone, the 21 American Republics plus the Dominion of Canada, present a mapping project which a few years back would have staggered the imagination. There are years of work ahead in the preparation of adequate base maps for all of these countries, not to mention the revision work which must be done periodically in order to bring these base maps up to date. The fact that in the 22 countries mentioned, English and Spanish are spoken in 20 of them, with Portugese in one, and French in another, might indicate also to the engineering educator the great desirability of adding Spanish to the curriculum or possibly making it a prerequisite for entrance to any recognized engineering school.

With the rapid development of aviation, radio, and communications, resulting in the shrinking of the earth's surface from a time and travel standpoint, it is becoming quite evident that more and more the relationship of any two countries is not dependent entirely upon the efforts of the various state departments and foreign secretaries. It is increasingly apparent that the professional man who may be employed in another country, either temporarily or permanently, must be considered as an "unofficial ambassador" of his own country while he is there.

This, then, is the challenge to the engineering educators. What they do about it is for them—and you—to decide. The opportunity is still there and I ask that you and the organizations you represent co-operate with and help them. Our engineering schools are an important part of our engineering profession. Let us keep that relationship in the field of surveying and mapping, also.

❦ ❦ ❦

THE SUM OF ALL SCIENCES

"What is needed to elevate the soul is, not that a man should know all that has been thought and written in regard to the spiritual nature—not that a man should become an encyclopedia; but that the great ideas, in which all discoveries terminate, which sum up all sciences, which the philosopher extracts from infinite details, may be comprehended and felt."

—Wm. Ellery Channing

Collimators Permit Rapid and Accurate Adjustment of Surveying Instruments*

By N. B. FOSTER† *and* L. C. HIGBEE‡

THE USE of precision optical apparatus recently assembled by U. S. Weather Bureau engineers for the collimating and adjustment of theodolites is proving highly successful. So much so that the procedure followed is considered to offer several advantages to cities and state highway departments in adjusting surveying instruments.

The apparatus is illustrated by the accompanying photographs. It consists of two infinite-focus telescopes mounted about 12 feet apart on rigid supports and in a horizontal position facing each other. For mounting the theodolite to be tested, a sturdy, adjustable elevation support is placed midway between the tele-

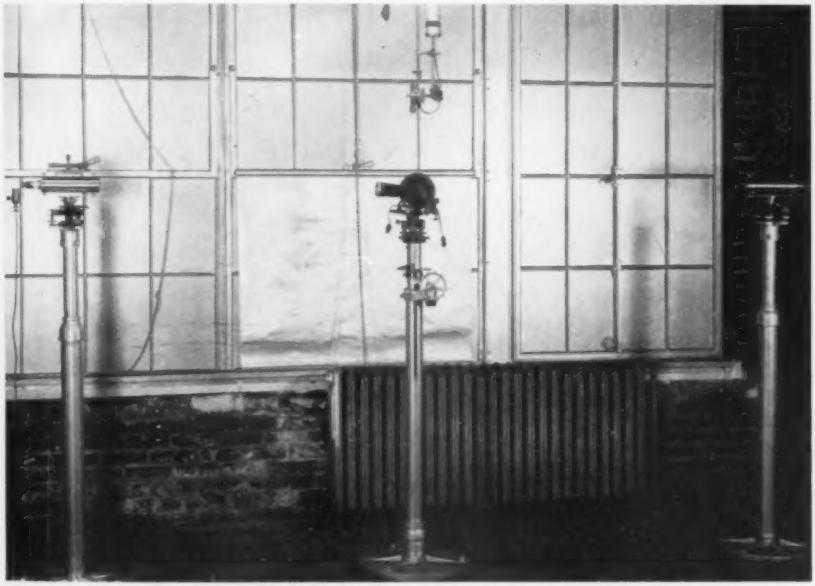

FIGURE 1.—Arrangement for collimating theodolite or transit.

scopes, which are referred to as horizontal collimators. A third telescope focused at infinity is supported in a vertical position directly over the theodolite stand, this instrument being rigidly supported by a pipe attached to an overhead girder.

In operation the horizontal collimators are adjusted to the same elevation, accurately leveled, and the cross-hairs in each collimator illuminated to serve as

* Reprinted through the courtesy of *Engineering News-Record*, October 18, 1945.

† Physicist, U. S. Weather Bureau, Washington, D. C.

‡ Engineer, W. and L. E. Gurley, Troy, New York.

targets. Due to the fact that the telescopes are focused for parallel light, the targets function as if they were placed several miles apart, one on either horizon and 180 degrees apart with respect to the theodolite to be tested. Illuminated cross-hairs in the vertical telescope serve as a zenith target, placed at 90 degrees from the horizontal targets.

Superior to Outdoor Methods

This method of collimating and adjusting theodolites, which permits a theodolite to be collimated to an accuracy of about 5 seconds of arc, is superior to outdoor methods usually employed because of a number of advantages. These include: the targets are effectively at infinity, rather than at relatively short distances away; temperature effects can be controlled, since the apparatus is confined in a small room; the adjustments are not affected by light shimmer due to variations in air density, as may be the case when checks are made out-of-doors; and finally, due to the rigidity of construction and installation, no difficulty is encountered from vibration.

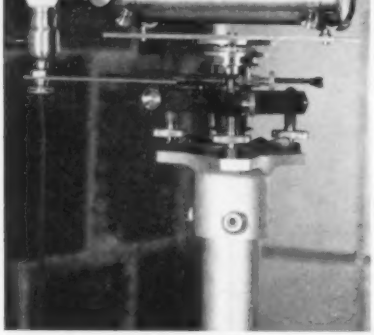

Figure 2.—A close-up of the horizontal collimator.

In addition, the method results in a considerable time-saving in servicing the Bureau's theodolites. Adjustment of an instrument outdoors by the previous method frequently required several hours. With the apparatus illustrated the work seldom takes more than an hour, and is frequently accomplished in 15 minutes.

Method Becoming Popular

Collimators are used in a somewhat similar way by the U. S. Coast and Geodetic Survey, while the General Land Office some time ago set up a room in which they employed collimators for adjusting solar transits. The highway departments of both Indiana and Mississippi use the method in maintenance and adjustment of surveying instruments, and Connecticut is training a man to do collimator work. Also, municipalities are beginning to utilize the procedure, Hartford, Conn. being at least one city now having a man trained in the shops of an instrument manufacturer for such work. The experience of these organizations, as well as that of the Weather Bureau, indicates that the method has many merits. It is to be noted that other agencies planning to follow the procedure described could substitute wye levels for the collimators, which might reduce the investment in the equipment but would not eliminate any of the advantages cited.

The apparatus was built of available materials by the instrument division of the Weather Bureau, and is used in the Bureau's laboratories at Washington, D. C.

* * *

MORE MEMBERS MEAN A STRONGER CONGRESS, AN IMPROVED JOURNAL

California Aerial Mapping Project

In March 1945, the State Project Committee on Aerial Mapping submitted its final report to the California State Reconstruction and Reemployment Commission in which it made specific recommendations for the complete aerial mapping of California during the next 10 years, as a co-operative arrangement between state and federal agencies on a parity basis. The report was prepared under the direction of Dr. Olaf P. Jenkins, Chief Geologist of the Division of Mines and chairman of the State Project Committee, and is based on thorough study, research, and investigation. The Committee sought and received advice from representatives of federal, state, and private agencies, and its conclusions and recommendations reflect the needs of a broad base of map users.

The report consists of 137 mimeographed pages and includes an appendix prepared by the U. S. Geological Survey on "A Mapping Program for the State of California" in which the present-day mapping methods of the Survey are discussed and evaluated.

Following the completion of the report, legislation for the mapping of California was approved on July 17, 1945 but with some modifications of the Committee's recommendations. The program was restricted to topographic mapping and was made the sole responsibility of the State Engineer. It calls for an expenditure by the State of $300,000 during the next 2 years, to be matched by an equal amount by the Federal Government.

The report contains many pertinent observations on the importance of maps and basic mapping programs, as well as on state responsibility in map making. The following extracts from the report are believed to have a general mapping interest and are reprinted in the hope that they will serve as an incentive to other states to initiate and undertake similar programs. A slight rearrangement in text from the published report has been made.

—EDITOR

STATE-WIDE demand for maps—better maps, larger-scale maps, maps made by modern methods which utilize aerial photographs—has prompted the State Reconstruction and Reemployment Commission to sponsor a State Committee on Aerial Mapping to investigate the subject and make recommendations to the State Legislature. The principal interested agencies (Federal, State, and private), both map makers and map users, have had a voice in the discussions. The report and recommendations of the Committee, therefore, are based on sound judgment from authoritative sources covering the broadest possible field.

STATE INVESTMENT IN MAPPING

Scope of Map-Usefulness

The usefulness of maps is far-reaching. Maps are of strategic importance to the War Department; they are vital to engineering, planning, and scientific enterprises; they control the development of manifold industries. The lack of adequate maps is a critical deficiency, for it blocks the progress of industry and civilization.

In military operations topographic maps are a prerequisite. For that reason the War Department has been obliged to prepare only within the last few years a large number of special military maps of the West Coast. This work should have been done long before the war by the State in co-operation with the U. S. Geological Survey.

The State Division of Forestry and the Federal Forest Service have been obliged to make their own maps for fire-control, because so many regions are inadequately covered by basic topographic quadrangles.

Many other governmental agencies as well as commercial enterprises have had to resort either to making their own maps to cover special problems, or to contracting the work through commercial mapping concerns—aerial mapping having been found most satisfactory. Much of this work is incompletely done; much of it is duplication; and very little is made generally available through publication. All of it could be more satisfactorily and economically accomplished simply by enlarging, extending, and modernizing the established co-operative federal-state mapping program. This is an established national program and is being carried on with various degrees of support by most of the states throughout the Union.

Adequate maps made by this means facilitate geologic exploration and development of water, oil, and mining properties; hydro-electric power development; land reclamation studies; tax equalization studies; location of rights of way for railroads, highways, pipe lines, transmission lines, and similar projects; vegetation cover studies; soil conservation studies; property surveys; disease control; city, county, and regional planning; land classification studies; lumbering activities; forest studies; fire-fighting; development of parks, recreation, and natural resources of fish and game; engineering construction; geologic reconnaissance; erosion control studies; road and bridge location; insurance studies; studies of landslides and all surface forms; archaeologic, zoologic, botanical, seismologic, and other related studies.

Since the advent of the airplane, photographs taken from the air have run close competition to regular topographic maps, because the pictures are on a larger scale and surface features of the earth are visible rather than symbolized. Practically all map users now find that aerial photographs are also essential in their work. Mosaics of photographs are especially useful in planning, while contact prints enable closer observation of detail (especially by means of the stereoscope) not always recognized from the ground. Only within the last few years have various methods and types of instruments been devised which take aerial photographs and accurately make real maps from them; for photographs are not maps—not even controlled mosaics made from photographs are true maps. Photographs and mosaics are most useful when employed in conjunction with topographic maps, where the surface of the earth is carefully measured in three dimensions and clearly recorded by means of lines and symbols.

Public Demand

The State Committee on Aerial Mapping has determined that there is universal demand—public, technical, and governmental—for basic topographic quadrangles of the high quality maintained by the U. S. Geological Survey. Large-scale, as well as small-scale, topographic maps of uniform accuracy and of high quality are required; also complete coverage of the State of California by such maps, published as soon as possible after completion in standard quadrangle form, which maintains standard specifications as to accuracy, correctness, completeness, cartographic clarity and uniformity, and general appearance.

Reponsibility of the State in Map Making

There are various needs and uses for which maps are made, and consequently requirements vary as to accuracy, scale, and general quality.

It would seem therefore to be an insurmountable task for the State to plan an all-embracing mapping program which would satisfy everyone; but any pro-

gram that is adopted by the State should lay the foundation for all further mapping of special features, natural resources, and various other needs. It should serve not only the greatest number of people, but satisfy the requirements of engineers, geologists, scientists, planning agencies, and all concerns upon whom the responsibility of progress in industry and civilization rests.

This has always been the object of the national topographic mapping program, which can be put into effective action only by co-operative state appropriations made available from year to year to meet the mapping requirements of map users. Changing requirements, however, and the trend toward larger-scale maps of higher quality and greater accuracy have caused differences in uniformity of maps produced. Furthermore, the lack of sufficient state appropriation has impelled other agencies than the U. S. Geological Survey to enter the field of mapping, with the result that there has been overlapping of endeavor, duplication of work, and a lack of uniformity and co-ordination. All of these deplorable conditions have fortunately been corrected to a limited extent by personal harmony and a fine spirit of co-operation among the engineers who are actually engaged in the work. The governmental agencies as well as engineers throughout the whole country admit that the established national mapping agency is the U. S. Geological Survey, and that the only criticism they have to offer is of the slowness of production of maps. This fault of slowness may be laid directly to the lack of sufficient state appropriation: one-half of the appropriation must be forthcoming from the legislature, the other half from Congress. Congress has never yet failed to match a state appropriation on a 50–50 basis for topographic mapping.

Dividends on the Investment

It is safe to say that the dividends on the investment will be many hundredfold the original cost. The discovery of a valuable natural resource, the starting of a new industry, the initiation of a great engineering enterprise; the assistance the map may give to planning future projects, or as the basis for a useful geologic map or soil survey, or as an aid in fighting or preventing costly forest fires, or as a strategic guide to military operations, may in each case be worth many times the cost of the entire project. There is no question as to the soundness of the investment.

The immediate use to which every topographic quadrangle is put, and the manifold ways in which it is used, together with the manifold agencies and industries which use it, make it impossible to evaluate in dollars and cents the actual value of a single quadrangle. Several thousand copies are printed of each edition and a single map is sold for only 10 cents (the cost of printing), enabling wide distribution and insuring general availability.

The sooner the maps are available, the sooner the returns. One topographic quadrangle alone (costing a total of possibly $10,000) may be used to plot and correlate information which may in turn lead to an important discovery and to the development of an industry worth millions of dollars.

The following is quoted from a report issued in 1940 by the California State Planning Board, *Surveys and Maps in California*, p. xi:

1. Existing topographic maps alone have saved the Division of Water Resources more than $2,250,000.—State Engineer Edward Hyatt.

2. The Metropolitan Water District of Southern California could have saved $750,000

had inch-to-the-mile contour maps of the southeastern part of the State been available.—Assistant Chief Engineer Julian Hinds.

3. Adequate maps of the Pit, Feather, Bear, and Stanislaus Rivers would have saved the Pacific Gas and Electric Company $200,000.—Vice President A. H. Markwart.

Recommendations

The Project

The State Committee on Aerial Mapping recommends immediate legislative action to provide for modern topographic mapping in the State of California under the supervision of the State Engineer, Division of Water Resources, Department of Public Works, in co-operation with the Federal Geological Survey, U. S. Department of the Interior; to provide an advisory council on procedure; to provide a central index service for maps, surveys, aerial photographs, and mosaics of the State; and to make adequate appropriation therefor.

Cost and Necessary State Appropriation

The total cost of the project has been variously estimated to be between $6,000,000 and $9,250,000, depending upon a number of changing factors such as: (1) scale of maps; (2) salaries of employees; (3) improvements in technique; (4) whether or not the program of work is planned from year to year to gain the maximum efficiency in engineering procedure. At least two-thirds of the State could be mapped in a 10-year period for a cost of $6,000,000, the State's share of the cost being $3,000,000, or an average of $300,000 per year. At the end of the 10-year period, the needs of the State should be reviewed and a new estimate made, if any new work remains to be done. Any suitable amount appropriated by the State Legislature would be matched dollar for dollar by Congress; the maps would be published as soon as possible after completion in quadrangle units, appearing from time to time. This total estimate is based on an estimate of $10,000 to $15,000 per 15-minute quadrangle-area for new mapping, there being over 700 15-minute quadrangle-areas in the State. More than half of these need remapping, and most of the others require revision.

The biennial appropriation necessary for the State administration of the program, for maintaining an advisory committee, and for establishing and maintaining a central index service for maps, surveys, aerial photographs, and mosaics, is estimated to be $20,000.

Administration

The State Committee on Aerial Mapping recommends that the established federal-state co-operative procedure in making maps be continued. This procedure provides the U. S. Geological Survey as the agency which does the mapping. In carrying on this mapping, it is understood that the program of the Survey will be co-ordinated with and supplemented by the mapping of governmental and private agencies, in order to eliminate duplication; provided that such work meets the specifications of the Survey and does not increase the over-all cost. Since the State agency for administering this co-operative work has for 40 years been the Division of Water Resources (State Engineer), the Committee recommends that this agency continue to administer the project.

There are many interested map-using State agencies which are entitled to have a voice in the program of work. In order to satisfy this condition, the Committee

recommends that an advisory council be established to advise the State Engineer on the plans and procedures of the mapping program from year to year.

It is recommended by the Committee that a federal advisory council similar to the state advisory council be established to meet with the State Engineer and State Advisory Council, in order to plan, for mutual benefit, a co-ordinated program of work.

It is the consensus of the Committee that the mapping program of the State should be established for a minimum of 10 years. However, maintenance of maps already made, or keeping them "alive," is universally demanded by map users, and should be one of the most important parts of the program.

The Committee has determined that there is universal need throughout the State for a clearing-house for information on maps, surveys, aerial photographs, and mosaics, which should provide a central index service to the general public.

Scale of Maps

The principal scales recommended are:

1:10,000 (1″=833 feet, approx.)—Original drawing of the multiplex aero-projector instrument.
1:24,000 (1″=2,000 feet)—Quadrangles of metropolitan areas.
1:31,680 (1″=½ mile)—Quadrangles of agricultural and special areas of economic concern.
1:62,500 (1″=1 mile, approx.)—Standard all-purpose quadrangles to cover the entire State.

By-Products of the Work

The Committee recommends that State agencies should be allowed to secure at nominal cost: (1) copies of aerial photographs taken during the procedure; (2) photostat copies of the original large-scale drawings of the maps, even before publication; (3) copies of planimetric maps printed without contours; and (4) transfers of the final plates for special jobs of reprinting, reassembling, or for overprinting.

Aerial Surveys for New Pipe-Line

AN AERIAL SURVEY of a proposed 365-mile pipe-line from Borger, Texas, to Denver, Colorado, being built by the Phillips Petroleum Company, has recently been completed by Kargl Aerial Surveys, Inc., of Midland, Texas. The pipe-line is the initial step in the creation of a vast terminal for storage and distribution of high-octane gasoline and other refined crude oil products in the Denver and surrounding markets.

Aerial photographs were taken at a scale of 1:20,000 with a 12-inch focal length lens automatic camera, using a P38-F5G Photographic Airplane. Mosaics of aerial photographs on the La Junta and Denver, Colorado terminals were completed, and abstract land ownership information was furnished for a 4-mile strip along the right of way, through 14 counties in the States of Texas, Oklahoma, and Colorado.

Postwar Opportunities in Private Practice

By S. A. BAUER*

I HAVE been asked to speak on "Postwar Opportunities in Private Practice."

In order to develop a background for such a talk, I felt it necessary to investigate the trends of private practice in surveying in the past. My own experience does not furnish much light, since I opened my office in 1926; and, although 1926 and 1927, I am told, were good business years, the problem of beginning a new enterprise consumed too much of my energy for me to learn much about business conditions. The year 1928 was not a good business year; and what came after that I prefer not to discuss. The war years brought on a considerable volume of specialized government work, but under abnormal conditions. The past year has been very active, and what will come in the next few years I am not competent to guess, since my personal experience came mostly during an extended and unparalleled business depression. For this reason I questioned some of my colleagues, relative to their business experiences in the past.

I found that, in general, the accepted index of surveying business is the number of parties in the field, and that unless one has several parties at work, one cannot expect a proper income from surveying. I found that, almost invariably, my fellow surveyors refer to certain widely spaced, short boom periods as periods of "good business," and the remainder as more or less unsatisfactory business. These short periods were always concurrent with periods of sudden and rather haphazard expansion in real estate, during which time the main problem of the practicing surveyor was that of getting enough men to turn out the work. As a result, the work done during these periods was often of uncertain merit.

The longer periods between these short periods of so-called "good business" were spent principally in coasting along at small, if any, profit. Intense and rather bitter competition between surveyors prevailed during these periods, while they waited for another period of prosperity. That has been the pattern of the surveying profession in our locality for some 40 years.

It seems quite clear that any business that spends most of its time at a mere existence level, waiting for occasional short periods of intense activity to provide a worthwhile income, is unsound and unhealthy in character. It seems clear also that there is something wrong with a profession that must rely for its income principally on the profits derived from its employees' efforts, rather than on fees for the services of the professional man himself.

If we are a profession worthy of the name, we surveyors should be able to earn a living essentially through our own efforts, services, and advice, rather than by acting as brokers of professional and subprofessional help. The professions of law and medicine are well capable of providing their members with incomes

Presented at Sixth Annual Meeting, American Congress on Surveying and Mapping, Washington, D. C., June 28–29, 1946.

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through the individual efforts of the professional men themselves. The doctor does not have to depend upon a profit from a number of employees for his livelihood. His fees for his own time are generally sufficient to provide him with a worthwhile income. He may have his assistants, technicians, nurses, and laboratory help; he may even derive some income from their efforts. But primarily the fees for his own time as a professional man provide him his principal income. The same is true of most other professions. Why, then, is it not true of surveying?

Our work is important; the ownership of all land is dependent upon it. Our profession is not a new and untried one; actually the origin of surveying is lost in history. Our work involves many skills: as practitioners we must be well versed in one of the most complicated and contradictory forms of law, the law of boundaries; we must be competent in mathematics; we must have a thorough knowledge of our community and its history; we must have sufficient personal integrity and standing in our community so that our word as arbiter and unofficial judge will bear weight in land disputes; we must be tireless in our search for the fundamental facts. We cannot depend on any handbook with a formula for every problem, nor can we rely on any factor of safety to compensate for our errors of calculation or judgment.

Why, then, can we not get a proper fee for our time? We generally, and quite truthfully, answer that we are not sufficiently appreciated by the world. Why is that true? Other professions are appreciated. The answer, I think, lies in the shortcomings of ourselves, the practitioners of the profession.

We surveyors are not sufficiently profession-conscious. We do not act like a profession. We are too proud of our individualism. We revel too strongly in our "practicalness," and shun theory as a bad thing. Too many of us are proud that we have not changed our method of operation in the past 20, 30, or even 40 years. Too many of us have not kept pace with the changes of time.

We are too prone to consider our way as the only right way, and to belittle the ways of our colleagues if they differ from ours. The "cross-section man" insists that stadia topography is "inaccurate"; the "planetable man" is sure that his is the only right method; and now we have photogrammetry. We are often not sufficiently broad-minded nor energetic enough to study and benefit by other techniques.

We are prone to sweeping and untrue generalizations in regard to procedures. No procedure has yet been invented for topography or any other form of survey practice that can serve for all times and conditions. Each technique has its time and place.

Other professions have a vigorous current literature in which the members exchange views and ideas, and develop new procedures, methods, and practices. Our profession has been content to remain secretive and fixed. We have been inclined to oppose change, and to resent exchange of opinions. As a result, we lack the unity of other professions. We lack a uniformity of practice and procedure. We are too inclined to disagree with each other as a matter of principle. We are our own worst enemies.

Good business conditions lie within our own power to make. The greatest opportunity the practicing surveyor has ever had to improve his economic and professional position lies within our grasp. All that the situation requires is that we guide our conduct as a profession by the professions around us, to elevate our position as professional men to the point where we can command sufficient

compensation for our own time and our own efforts. This, I think, is the great postwar opportunity in private practice.

The means to do this are in our hands. The American Congress on Surveying and Mapping—now 5 years old—is in a position to take the lead as a national body to provide us with the unified organization that is a necessary part of every professional movement.

I wish to make clear that I am not advocating the Congress as opposed to other organizations. I myself am a member of the National Society of Professional Engineers, the Ohio Society of Professional Engineers, the Cleveland Society of Professional Engineers, and the American Society of Civil Engineers. These organizations have their definite and important places. However, the representation of the surveyor in the American Society of Civil Engineers is limited and is principally in the direction of the development of the theory of surveying, with special emphasis on its relationship to engineering. In the professional societies, the surveyor as such is not included in the membership of the National Society of Professional Engineers. The American Congress on Surveying and Mapping is the one organization that can act as the spokesman for the entire profession of surveying in social, economic, and professional matters, and on a national scale, in much the same way that the National Society of Professional Engineers acts for the engineer, the American Medical Association for the doctor, and the Bar Association for the lawyer.

Progress is being made. The Congress is growing. The Property Surveys Division of the Congress is actively engaged in developing such a professional consciousness. We have presented for the first time uniform Standards of Practice† for the performance of property surveys. We have many plans for future activities. The Congress, vigorously supported by the practicing surveyors throughout the country, can create the standards, the literature, the procedures, the professional attitude, and the unity of effort that are necessary to raise the profession to its proper level in the eyes of the world. It can achieve ultimately for surveyors an income commensurate with the services rendered, and comparable to that of other similar professions, at the same time increasing the value of our services to our fellow men.

Our immediate task is that of educating ourselves, and then the lay public, to our own importance and value. When we have done that, we will have done more for ourselves than all of the government make-work programs combined ever did.

† See page 210 of this issue.

* * *

ECONOMIC VARIETY THE SPICE OF LIFE!

"There is deep intuitive wisdom in this American tolerance of economic variety and in our refusal to commit ourselves to any one social and economic system. It is recognition of the fact that life and truth are too varied and complex to be confined within the pattern of any single deliberately planned economic system."

—Arthur E. Morgan

Engineering Surveys in Highway Planning and Construction

By WILSON T. BALLARD*

THE ROMANCE of adventure that has always surrounded the surveyor with his strange instruments, high boots, and sun-tanned exterior has without doubt caused many a young man to make engineering his career.

Surveying has from the earliest times been a most elemental and basic phase of all of the constructive activities of men. It is truly pioneering—and pioneering will never fail to stir the imagination of red-blooded men. The great statue of John F. Stevens that marks his discovery of Maria's Pass, which enabled the Great Northern Railroad to reach the Pacific Coast in the early days, proved that these facts have been recognized.

Willard Beahan's thrilling stories told to a group of us as undergraduates made us all envious of the rugged boys who pushed the railroad westward in the early days. After an evening with him, we often wondered whether railroading might not have been somewhat a side issue to Indian fighting. Those days are long since gone, but the glamour of measuring the earth and orienting one's self with the aid of star or sun preparatory to locating and building roads and bridges and canals, still remains.

Soon after the turn of the century, the motor driven conveyance appeared and soon began to require improvement of the highways. At first this consisted almost entirely of hard surfacing wagon roads. Little, if any, surveying was required; certainly nothing beyond a rather simple traverse, with sometimes levels, referred to an assumed datum plane.

The development of motor transportation in this country quickly outdistanced the vision of most, if not all, of the early road builders. It soon became clear that real attention to location, alignment, grade, and sight distances was a necessity; and the surveyor quickly came into his own in the business of highway location and construction. Today from the earliest inception of a project until the road is put in service, his work provides the chart guide and control of all activities from preliminary location to final payment of the contractor.

Surveying for Highways

Every important highway project requires map and field reconnaissance, preliminary traverse, trial locations, and finally—after selection of the best line—a detailed location survey staked out and showing cross sections, super-elevated curves with spiral transitions, and detailed bridge site and drainage surveys—all as thoroughly done and with all the refinements ever required in railroad work. Thus only can modern traffic volume and speed be adequately served.

I shall not discuss the technical details of such surveying, for I am sure that to do so in such a group as this would be a poor reading of your own books. I

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* Chief Engineer, Maryland State Roads Commission.

would like to emphasize a need that I know is being recognized, but one that we all would like to see fulfilled more rapidly than at present.

Early highway surveys were made without permanent horizontal or vertical control. Many, even including very important projects, are still being made so. If accuracy is to be assured, as it must, this procedure requires much unnecessary work in closing traverse loops, both horizontal and vertical. In addition such a survey cannot be re-established readily without a great amount of work. Furthermore, it fails to produce a system of surveys properly interrelated with one another.

The cure is at hand if the systems of State Plane Coordinates that have been adopted in many states are adopted by all and universally used, and if the bench marks (referred to a sea level datum), which are generally available without too much additional work, are tied into.

To obtain the extensive and detailed information that is necessary before the best location for important highways—such, for example, as those that will go to make up the 40,000-mile Interstate System—can be selected, a vast amount of time, labor, and money must be expended in surveying, unless advancing science can provide a method which is much faster and just as reliable as the old methods that depend on transits, tapes, levels, and numerous five- and six-man parties.

Fortunately, I believe this is to be realized through the medium of the airplane and the aerial camera, together with the highly refined stereoscopic office equipment.

Today complete and sufficiently accurate detailed topographic surveys are being made of areas a mile or more in width, and of any desired length, in a small fraction of the time and at far less cost, than would be required to obtain the same surveys by old ground methods. Maps to convenient scale, 1 inch to 200 feet, or 1 inch to 100 feet, if desired, with 5-foot contour intervals and showing all existing roads, buildings, and other man-made features, are produced rapidly in the office; and upon them final location can be projected with confidence, and thereafter staked out in the field to control construction. A comparatively small amount of field work is necessary to establish control points and elevations, and this can be done quickly.

Maryland has recently completed such a survey 17 miles in length, extending from the western boundary of the District of Columbia towards Frederick along the line proposed for relocation of U. S. Route 240, which is a portion of the established Interstate System. The final topographic sheets produced by this survey, on a scale of 1 inch to 100 feet and with 5-foot contour intervals, were carefully checked by means of ground profiles run in several representative areas through both wooded and open terrain. They were found to fully meet the accuracy guaranteed by the contract—that not less than 90 percent of any points selected shall be within a half-contour interval from the elevations determined by the ground check.

This survey was accomplished in two stages. The first flight produced a photomap of a strip 1 mile wide at a scale of 1 inch to 500 feet, with a 10-foot contour interval. On this map and with the aid of the contact prints of photographs, a strip 800 feet wide, in which it appeared certain that the best location lay, was established. The 800-foot strip was reflown to produce the final sheets at a scale of 1 inch to 100 feet with 5-foot contour intervals. This survey is coordinated with the grid of the State Plane Coordinate System and elevations are

referred to the U. S. Coast and Geodetic Survey datum. Plats of all recorded (or otherwise available) and as yet undeveloped land subdivisions are being superimposed on the final topographic sheets. The result will provide for the selection of the final location.

An excellent paper, "Aerial Surveys Expedite Highway Planning," presented in The American Association of State Highway Officials Papers and Discussions, 1944, by Samuel Nelson, describes a similar survey made for the Palisades Interstate Park Commission of New York State. A number of other states are using this method.

Thus far, I believe no one has seriously considered the possibility of developing and administering grading contracts without first staking out the final location on the ground, and taking field cross sections in the usual way, in order to establish earthwork quantities for the contract. This feature has been discussed with some of the larger grading contractors. It has also been considered in Mr. Nelson's paper, and I believe the time may not be too far distant when the preliminary cross sections can be established in the computing room from the topography shown on the final sheets produced by the aerial photographic method. If it does, the only field work that will be required after completion of the aerial survey, and before advertising a contract, will be the staking out of the final location centerline, thus effecting a great saving in time and engineering cost.

As a valuable by-product of this method, the contact prints of photographs, I believe, will greatly help in dealing with a property owner when obtaining the right of way. He can visualize far better the effect of the construction on his property than is possible for him when confronted with the right-of-way plats now in use.

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Deserted Meridian

THE EARTH'S ASTRONOMICAL NAVEL was about to shift its position. Britain's Royal Observatory was preparing for its first permanent move in 271 years. Left behind in Greenwich (now part of London) would be (1) the original building designed by Sir Christopher Wren, and (2) the "prime meridian of longitude," which passes through the observatory grounds. The "Meridian of Greenwich" could not be moved; every modern map in the world had been drawn with it as a base line.

Ships visiting London used to send their chronometers to Greenwich to be set by telescopic observation of the stars. After 1833, their officers watched a 5-foot ball on a pole above Sir Christopher's building. When it dropped, the "Greenwich time" was 1 P.M. The custom led, in 1884, to an international agreement fixing the meridian of Greenwich as "zero longitude." The maps of the world still use this north-and-south line as a starting point. The world's clocks are still set by reference to its time.

But time, in other respects, was not kind to Greenwich. Like an ugly fungus, London crept around King Charles's royal park. The city's smoke blinded the telescopes, corroded metal parts, covered lenses with soot. Electric railways interfered with magnetic observations. Worst were street lights, whose glare outshone the Milky Way. Only British astronomers could have hung on so long.

Traditionalists among them had little need to mourn. The observatory's new home will be older than its old one: Hurstmonceux (pronounced herst-mon-syoo) Castle in Sussex, built in 1446. From its grounds new and old telescopes will observe the smokeless sky.—Condensed from *Time* Magazine, April 29, 1946.

Roman Surveying Instruments*

FIGURE 1

INFORMATION concerning the character of Roman surveying instruments is meager and confined principally to the writings of three outstanding authorities and to archaeological discoveries. For a better understanding of the subject we may explore briefly the chronological skeleton of their heritage from the ancients.

Astronomy was the parent of all measuring sciences because primitive man had no clocks. The Chaldeans were pioneers in measuring, as witnessed by the graduated scale beside the carved fortress on the lap of the statue of the Chaldean engineer-architect (fig. 1) dating back to 4,000 B.C.

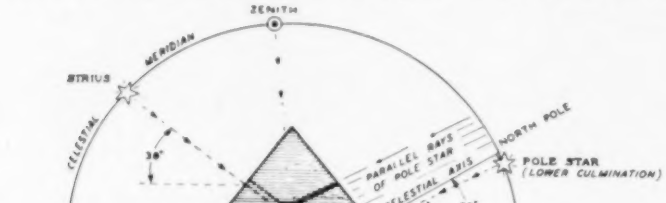

FIGURE 2

2877–2800 B.C.—The Egyptians oriented their Great Pyramid (fig. 2) from their pole star Alpha in the constellation Draco (the Dragon).

Seventh century B.C.—The Greek Thales of Miletus used geometry to measure the heights of pyramids (fig. 3) by means of similar triangles.

Sixth century B.C.—Pythagoras measured the obliquity of the ecliptic, taught the earth was a sphere poised in space, and enunciated his famous theorem.

Fourth century B.C.—Plato proclaimed that the sun revolved about a globular earth, and Euclid systematized geometry in his celebrated "Elements," based upon the premise that parallel lines never meet.

Third century B.C.—Archimedes' doctrine of a sun-centered celestial system is met with scorn. Eratosthenes made a close approximation of the length of the circumference of the earth by simultaneous solar observations at Alexandria and Syene (Assuan) on the Nile.

Second century B.C.—Hipparchus of Bythinia systematized astronomy and introduced the Astrolabe (fig. 4), an instrument for measuring angles in degrees.

* Reprinted through the courtesy of *American Highways*, October 1945.

Having sketched above the measuring knowledge available to the ancients, we may now proceed to describe the surveying instruments and methods of the Romans as expounded by three outstanding authorities. The first of these is

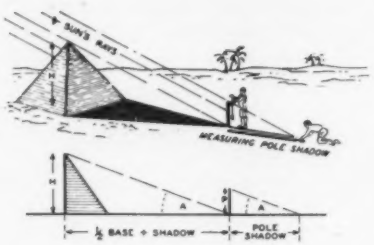

FIGURE 3

FIGURE 4

Hero, a Greek mathematician and mechanician of Alexandria, who published a textbook in which he describes an instrument called a Dioptra, possibly 130 B.C. Hero acknowledges similar devices in use long before his time but claims his own an improvement over them all. He states the Dioptra may be used to lay out water channels, ramparts, harbors, and buildings; for astronomical measurements; for suveying land; and in warfare to measure inaccessible enemy-occupied areas, and to determine the height of ladders needed to scale ramparts while keeping beyond the range of hostile missiles.

The Dioptra (fig. 5) consists of a copper tube 63 inches long, set in and supported by a wooden rod 6 feet (4 cubits) in length. Each end of the copper tube is bent upwards 1½ inches (2 digits) to support a glass tube about 9 inches (12 digits) high fixed to wooden standards. Sighting apertures across the water levels in the tubes are adjusted vertically by a screw beneath the rod. The hori-

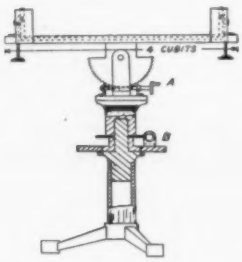

FIGURE 5

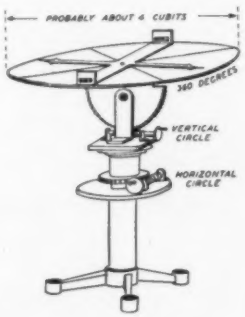

FIGURE 6

zontal rod or alidade is fixed to a vertical circle moved by a worm gear and a horizontal circle is controlled by the tangent screw *B*. So constituted it may be used for leveling or alignment. For alignment only the level is replaced by a

horizontal circle (fig. 6) divided into 360 degrees, with two right-angle lines for ordinary surveying, and a revolving alidade for sighting.

The two leveling staves described by Hero (fig. 7) were similar to the target rods now in use. Each were pieces of wood 15 feet (10 cubits) long graduated into cubits (17½ inches), palms (2⅞ inches), and digits (¾ inch). A black-and-white circular target 10 to 12 digits (7½ to 9 inches) in diameter, fixed to a tenon, slid up and down in a groove in the rod and was raised or lowered by a cord running over the pulley at the top. A pointer fixed to the target indicated the rod readings. The rod was made perpendicular by the plumb line at the side. Levels were run by the differences between backsight and foresight rod readings just as we do today. Stakes were set for gradients and bench marks were established at intervals.

Hero describes 20 problems solved with the aid of the Dioptra, including: (1) running a line between two points neither of which is visible from the other; (2) finding the horizontal distance from an inaccessible point or between two inaccessible points; (3) laying out horizontal distances by similar triangles by sighting on two readings on a graduated pole placed near the instrument; (4) measuring the heights of inaccessible points; (5) aligning straight and curved tunnels; (6) laying out curves for harbors, amphitheatres, and arches, by a template bolted to the circular alidade and sighting in points on the curve; (7) the measurement of accessible and inaccessible areas; and (8) the determination of the angular distance between stars and the distance between two places, such as Rome and Alexandria, with the aid of "Records," similar to our Ephemeris.

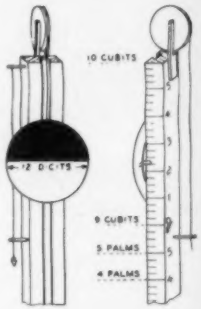

FIGURE 7

Hero mentions a tape only once and then in connection with a curved tunnel. "It must not streteh on pulling nor contract with moisture."

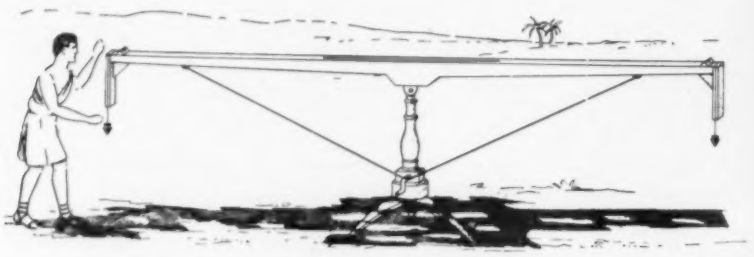

FIGURE 8

The second of the outstanding authorities, Marcus Vitruvius Pollio, master of architecture, who presented his Ten Books to his patron Augustus Caesar about 25 B.C. prefers the Chorobates to the Dioptra for leveling hydraulic gradients to cities and houses. He describes the Chorobates (fig. 8) as a rod 20 feet long with a piece, squared downward on each end, on which are scribed lines, at the top of which plumb lines are suspended. The Chorobates is leveled by tilting the

horizontal element by a screw until the plumb lines and scribed lines coincide. When there is too much wind for plumb lines, water is poured into a groove in the top of the horizontal element. Water will give a true level even though Archimedes said the earth was round, says Vitruvius, because the surface will correspond to a circle with the earth as a center but each end of the water in the groove will be level.

Vitruvius also describes a device handed down by the ancients for measuring traveled distances by a counter fixed to the wheels of a chariot similar to our odometer.

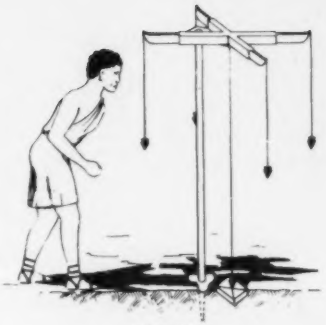

FIGURE 9

The last of the three outstanding authorities is the distinguished hydraulic engineer Sextus Julius Frontinus (c. 35–104 A.D.). Quotations from his lost treatise on surveying contained in the Codex Arcerianus, written in the sixth century, describe the surveying practices of the Roman *agrimensores* (field measurers) and *gromatici* (Groma users). The latter are named for the favorite aligning instrument of the Romans, resembling a surveyor's cross, that satisfied the bulk of their requirements—laying out straight lines and right angles. The Groma (fig. 9), as reconstructed by recent authorities from original writings and archaeological discoveries, consisted of a vertical iron staff (*ferramentum*) about 5 feet long, pointed at the lower end, and with a cross arm, 10 inches long, pivoted at the top, which supported the main aligning element—the revolving *stelleta* (star) with arms about 3½ feet across. The two main roads at right angles in a Roman camp were located by sighting beside the two plumb lines suspended from the end of the cross arms to coincide with the central plumb line over the selected central point. Areas of fields were measured by setting out two right-angled lines, joining their extremities by straight lines and finding the perpendicular offsets from these to the irregular sides. Although the Groma could be used as a level, Hero is supposed to have condemned it for this purpose as compared with his own Dioptra.

In conclusion, an inspection of Roman roads, aqueducts, canals, buildings, city layouts, and land subdivisions confirms their unexcelled proficiency in the use of their crude surveying instruments as measured by present-day standards. After a careful review of the extant data we may add that:

1. The range of their instruments was restricted to the vision of the naked eye. Magnification by telescopic sights was not invented until 1608.

2. There is no evidence of the use of the compass by Roman surveyors although it was known to the Chinese for two milleniums B.C.

3. The Romans had only a few crude maps of large areas laid out by latitudes and longitudes.

4. They used a device similar to our planetable but the art of distance measurement by stadia cross hairs—tachymetry—was not invented until the seventeenth century.

5. Their entire astronomical and geographical outlook was circumscribed by the idea of an earth-centered universe and a rigid Euclidian geometry excellent for earth measurements but elementary when projected into space. They understood a great deal of algebra and trigonometry and some of the rudiments of calculus.

Property Surveys Division

Technical Standards for Property Surveys

EDITOR'S NOTE.—The following set of Technical Standards for Property Surveys was devised by the Technical Division on Property Surveys of the American Congress on Surveying and Mapping. It was submitted to the membership of the Congress and adopted in the published form at the Sixth Annual Meeting of the Congress on June 28, 1946. Mr. S. A. Bauer, a practicing surveyor of Cleveland, is Chairman of the Property Surveys Division. The preparation of the Standards was under the immediate charge of Mr. William C. Wattles, Chief Engineer, Title Insurance and Trust Co., Los Angeles and Chairman of the Technical Standards Committee. In addition to the Standards there is published a number of Supplemental Recommendations—also prepared by the Technical Standards Committee—which while not actual Standards, are nevertheless essential for the guidance and development of the profession. Mr. Wattles' comments on the Standards will be found on page 215 of this issue. Reprints of the Standards together with Mr. Wattles' comments are available to interested persons upon request to the Acting Secretary, American Congress on Surveying and Mapping, Box 470, Benjamin Franklin Station, Washington 4, D. C.

Foreword

The American Congress on Surveying and Mapping has adopted the following set of Technical Standards for Property Surveys for the instruction and use of the members of the Congress and affiliates, and all others who have occasion to use them. The Congress hereby authorizes any changes, alterations, amendments, additions, or deletions, from time to time, as the occasion may arise, provided such variations are made with the consent and under the direction of the proper officers or committees of the Congress. These Standards may be segregated as to any or all parts, or revisions thereof, for particular use in any locality requiring them, without necessitating any change of form or recommendation in other parts of the Standards required or used by other sections. It is understood that these Standards are recommendatory only, and not mandatory. It is the hope of the Congress that members will use their influence, sponsorship, and recommendations in any proper capacity to promote the beneficial operation of such Standards.

FRANK S. BORDEN, *President*

TECHNICAL STANDARDS

I. LAND TITLES AND LOCATION

Every parcel of land whose boundaries are surveyed by a licensed surveyor should be made conformable with the record title boundaries of such land. The surveyor, prior to making such a survey, shall acquire all necessary data, including deeds, maps, certificates of title, centerline, and other boundary line locations in the vicinity. He shall compare and analyze all of the data obtained, and make

the most nearly correct legal determination possible of the position of the boundaries of such parcel. He shall make a field survey, traversing and connecting all available monuments appropriate or necessary for the location, and co-ordinate the facts of such survey with the predetermined analysis. Not until then shall the monuments marking the corners of such parcel be set, and such monuments shall be set in accordance with the full and most satisfactory analysis obtainable.

Any descriptions written for conveyance or other purpose, defining land boundaries, shall be complete and accurate from a title standpoint, providing definite and unequivocal identification of the lines or boundaries, and definite recitals as to use or rights to be created through such descriptions. Any form of description, regardless of presence or absence of any or all dimensions, but specifically tying to adjoiners, which fulfills the foregoing conditions, is acceptable. However, such description, insofar as possible, in addition to all necessary ties to adjoiners, should contain sufficient data of dimension, determined from accurate field survey, to enable the description to be completely platted. It is also advisable wherever correct surveys have determined the coordinate values of boundary corners or monuments recited in a description, to make proper reference thereto in the description by any appropriate recital.

Any surveys made for purposes other than location of land boundaries need only the ordinary information and data necessary to fix the situs of the work to be done, by one or more ties to some known and accepted title boundary line or corner, together with such other data as may be required to tie the project into adjoining matters appurtenant.

II. MAPS

Every land survey requires a map properly drawn, to a convenient scale, showing *all* the information developed by the survey; also a proper caption, proper dimensions and bearings or angles, and references to all deeds and other matters of record pertinent to such survey, including monuments found and set.

If the survey is made for purposes other than land location, then the map should be conformable to the needs of the work authorized to be done, giving all the necessary information in conformity therewith.

Wherever provided by law or whenever necessary to perpetuate valuable evidence of land line locations, a map of the survey should be recorded in a public office in accordance with the provisions or permissions of the law in the particular state in which the survey is made.

Every map submitted to a client or presented as a public record must bear the name of the Licensed Surveyor responsible for the work, his official seal or license number, and the date.

III. COORDINATE SURVEYS AND BASE TRIANGULATION SYSTEMS

The use of the coordinate survey systems of the U. S. Coast and Geodetic Survey and the U. S. Geological Survey is to be encouraged in all states.

The establishment of secondary triangulation systems tied in and properly related to such coordinate systems is also recommended.

Wherever available, within reasonable distances, every land survey is to be connected with two or more monuments of the main or secondary triangulation system; and the maps of such survey shall show the correct verified coordinates of such monuments and of at least two of the monumented corners of such survey.

IV. MEASUREMENTS

Measurements shall be made with instruments capable of attaining the required accuracy for the particular problem involved. All tapes shall be calibrated to government standard for temperature and pull, and all measurements in the category of accuracy of 1 part in 10,000 or greater shall be made, taking into consideration such temperature and pull in the actual field work.

All transits shall be maintained in close adjustment and the projection of lines shall be made with the system of double centering or proper adjustments made to field readings by predetermined coefficient of error. All angles with a transit shall be determined by the continuous repetition or run-up method, dividing the sum total of the angles by the number of repetitions for the average value of the measured angle.

All leveling instruments shall be maintained in close adjustment, and the readings of elevations shall be made with equal foresights and backsights as nearly as practicable and/or proper adjustment made to field readings by predetermined coefficient of error.

The minimum accuracy of linear measurements between points shall be 1 part in 10,000 on all property lines of boundary or interior survey. Preliminary or reconnaissance surveys shall maintain an accuracy of not less than 1 part in 5,000, except in those cases where general information only is to be obtained and no precise monumented corners are to be created.

In a closed traverse the sum of the measured angles shall agree with the theoretical sum by a difference not greater than 5 seconds per angle, or the sum of the total angles shall not differ from the theoretical sum by more than 90 seconds, whichever is smaller.

A circuit of levels between precise bench marks or a circuit closed upon the initial bench mark shall not differ more than 0.02 foot multiplied by the square root of the number of miles in the circuit, and in no case to exceed 0.05 foot, except in levels for preliminary or rough stadia control, in which case the allowable error of closure may be 0.10 foot.

All field measurements must be balanced, both as to angles and distances, so that the dimensions shown on the map of such survey will be mathematically exact; this will permit the proper use of the prorate method in field relocation.

Bearings or angles on the map shall be given to the nearest 5 seconds; distances to the nearest hundredth foot.

Accuracy of measurement in triangulation dimensions shall conform with the standards set by the U. S. Coast and Geodetic Survey.

V. MONUMENTS

The type and position of monuments to be set on any survey shall be determined by the nature of the survey, the permanency required, the nature of the terrain, the cadastral features involved, and the availability of material.

Monuments set in an inhabited area with improved streets, buildings, and other more or less permanent topographical features, shall be such as will remain for the life of such features and may be set in contact with or alongside of such semi-permanent structures with reasonable security. Monuments set in open country where their maintenance is to be continued for long periods shall be of a material such as concrete, rock, or metal, of sufficient size that they will not be

readily removable and will be easily discoverable; and witness monuments of ready visibility shall be placed alongside or nearby, if necessary.

Except in the case of original surveys, in which monuments are to be referred to in the record, permanent monuments shall not immediately be placed on lines or in positions where their destruction is more or less immediate by reason of construction; but semi-permanent monuments, such as stakes, pipes, or other material, shall be set in protected spots at definite known distances from the true corners for purpose of location of such corners after construction is completed. The surveyor shall make a definite commitment of record, that he will correctly set such true corners as soon as their permanence in position can be assured.

VI. PLANNING AND DESIGN

No standard is set for planning and design of land line location as to the form and position of such lines. Each particular problem carries its own plan and its own design within itself. A plan acceptable in one locality or under some conditions may not be adaptable in another.

SUPPLEMENTAL RECOMMENDATIONS

I. LEGISLATION

The Congress recommends and urges its members to consummate in every state the enactment of satisfactory legislation to provide for:

1. Licensing of land surveyors and making provision for:
   (a) survey of boundaries of land holdings and the accurate measurement of any and all cadastral and topographic features, including the establishment of grades and alignments for highways and for public and private utilities;
   (b) practice and procedure in the making of surveys, filing of maps as a public record, filing of reports and other necessary items, and for the nature, setting, and marking of monuments;
   (c) prohibition of practice or assumption of responsibility, or claim as a surveyor, by anyone not licensed as such;
   (d) penalties and means of enforcement to compel compliance with the licensing law.
2. A law permitting and legalizing the establishment and use of the coordinate system of surveys as developed by the United States Coast and Geodetic Survey.
3. A law for the survey, platting, and recording of maps of subdivisions of land into lots or parcels, providing for:
   (a) procedure, data to be shown, and method of filing the maps;
   (b) requirements as to street lay-out and provision for dedication of easements;
   (c) verification of accuracy of title lines and boundaries;
   (d) consent and affidavits of landowners in the subdivision;
   (e) penalties and enforcements of the law;
   (f) other necessary matters to provide a complete and accurate record of the subdivision in all its parts.

II. EDUCATION

The Congress endorses and recommends a program of education by means of curricula in universities, colleges, and other schools, particularly designed to teach title location and survey methods, together with the necessary legal phases thereof. Courses should be provided in various communities under the sponsorship of edu-

cational institutions, for the spreading of information on all phases pertaining to land survey work, such as law, titles, descriptions, interpretations, analysis, and title relocation and survey, as well as including the present systems of technical training in mechanical procedure.

III. BIBLIOGRAPHY

A central bureau of information shall be set up, as the Congress may provide, in which data on laws governing land surveys, other data associated with land title and boundary location, and technical and mechanical survey information may be deposited. Such information shall be available on request to anyone who may have occasion to use it. Engineers and surveyors are to be encouraged to submit information, valuable data, or problems to the bureau for reference, analysis, and discussion. The Journal of the Congress also shall be used as an intermediary for the dispensing of information pertaining to the Property Surveys Division. Special issues of the Journal or other papers may from time to time be printed and distributed to the members.

IV. ETHICS

There shall be established and promoted among the members of the Congress, their affiliates and associates, a standard of ethics, both in theory and practice, fulfilling as far as possible, the following endeavors:

1. Complete and accurate professional procedure.
2. Verification of all statements, whether by field work, map, report, or other means of communication.
3. Establishing and maintaining harmonious, fair, and honest contacts and dealings with other members of the profession and clients.
4. Creation and maintenance of a high standard of integrity and ability in the personnel of land surveyors and their assistants.
5. Recognition and promotion of land surveying as a definite profession, entitled to all of the dignity and respect accorded to other professions, as distinguished from business or industrial occupations.

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ENGINEERS IN WORLD AFFAIRS

"There is need for acquisition in college of a firm understanding of those ethical principles that must guide every faithful practitioner of a learned profession. No hard and fast rules of conduct exist, but there are certain standards of faithful service to the public and to the community, standards of fairness and consideration for colleagues and for rivals. Unless the young practitioner recognizes these things, he is in no true sense a member of a learned and enlightened profession.

"The engineer is above all a member of society and as such it is his duty to co-operate with other men of earnestness and good faith to advance its interests, to improve the welfare of his community, to do all in his power to make this world a better place in which to live. If he ignores these obligations and confines himself to his laboratory or his office, letting the world go by, he may yet be set down as a clever technologist but not as a real engineer."—From recent address of C. R. Young, Dean, Faculty of Applied Science and Engineering, University of Toronto.

Standard Specifications for Private Practice Surveyors

By WM. C. WATTLES*

SINCE the beginning of history the acts and works of man have been based upon ideas and concepts governing their performance. Every plan and structure was elaborated under the aegis of a standard of practice higher in quality and greater in scope than the works it overshadowed. Every business, industry, or profession operates and develops through some standard whether crude or mature; the profession of land surveying is no exception.

Prototypes must be revised from time to time and raised in tone and quality to care for increased necessities and capabilities of the projected works. A standard may not be such unless it is greater and broader in concept than the acts performed through it.

The level of any standard is gaged by the tools of operation, the necessities of the time, and the capacity of the promoters to approach in construction the ideals of the standard. It is a far cry from the strips of bull's hide used in the legendary survey of Carthage to the modern precision instruments of measurement, yet in each case the tool and the need correspond to a standard fitting the occasion.

As a tree has a basic trunk and a multiple development in its branches and leaves, so must a standard have fundamental principles supplemented by the necessary expansions and ramifications required to exploit those fundamentals. Every state has its own problems more or less widely different from others. Consider Massachusetts or Connecticut; heavily populated, split into small compact areas, generally unchanged in boundaries over a long period of time, and well stabilized in methods of control. Contrast this with California; second largest state in the Union, 158,000 square miles, its people concentrated mainly in the principal centers of the San Francisco Bay area and the Los Angeles coastal plain, property holdings ranging from thousands of acres in a single unit down to a small city lot, Los Angeles County only slightly less in area than the state of Connecticut with over two million assessed parcels of land, and Los Angeles City comprising more than 400 square miles of incorporated territory. It is evident that the specifications governing land boundaries, the legal and title aspects of location, and the methods of development must be widely differentiated except for basic principles and accuracies. The Technical Standards† submitted by the Committee on Technical Standards of the Property Surveys Division of the Congress have been drawn with careful consideration of the various channels of application of these basics.

Elements of a Technical Standard

The generally accepted idea of a technical standard in surveying is that in

Presented at Sixth Annual Meeting, American Congress on Surveying and Mapping, Washington, D. C., June 28–29, 1946.

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† See page 210 of this issue.

which the precisions and limits of measurement, either linear, angular, or of elevations, are established. This, of course, is sufficient for the normal mechanical procedure of surveying, but real land survey practice must go beyond the mere mechanics of its physical placements and determine the legal and title facts of boundaries and ownerships, and their relations with each other.

In the location of boundaries it is essential to understand the laws governing ownership of land, transfer of titles thereof, legal interpretations of the nature of such boundaries, and the language in conveyances defining them. It is also necessary to understand the specific identities or differences between physical positions and record positions. The business of the surveyor is not that of measuring lines as given to him by word of mouth, sketch, or description without considering the source, value, or relationship of such lines to others of associated boundaries or ownerships. He must of necessity correlate all facts concerning the property in question in order that his placement of monuments will be correct not only in mechanical measurement but likewise from a legal and title point of view.

Legislation and Education Needed

The Standards of Practice submitted to the Congress stress, among other things, the necessity for law and legislation to define procedures and to control the personnel and activities of land surveyors and surveys. The law, itself a standard, forms a natural base from which to operate and direct other standards. Regardless of good intentions and a spirit of co-operation among certain groups, it is impossible to maintain and enforce any standard without legal authority to do so. It follows, then, that such legal authority should not only impose a penalty for non-compliance with the rules, but should set up those rules on a broad basis and determine the status and licensing of surveyors properly to execute the precepts and intent of the law.

It is patently impossible in this set of standards to cover the legal ground necessary for the proper practice of land surveying other than the suggestion of a few fundamental principles. Every state, or community within the state, has its own peculiar problems, its own laws governing property and associated matters, its own necessities, and other conditions which vary materially from requirements of other localities. It is evident that only basic principles will be applicable to such a multiplicity of problems; therefore the Committee has recommended in the standards that the various communities and states be urged to pass legislation commensurate with their particular needs. It should be borne in mind that a certain flexibility must be provided in the law so that standards may be raised in quality and operative functioning at any time the need demands.

The Committee calls attention also to the paragraph on education and the urgent need for developing and spreading its principles. The failure and poor performance in land surveying is, in great part, due to lack of knowledge of the principles involved, and an inability to gain such knowledge through the ordinary sources of curricula, books, or personal contact with those who are more familiar with the subject.

The problem of land titles as associated with surveying is generally misunderstood. The prevalent idea seems to be that a record title will invariably and definitely follow the monuments and measurements of a survey regardless of their accuracy or sufficiency. This belief is always open to question and the case is

always subject to review. It must be understood that a survey follows title as often as it precedes one. If a record is created on paper, the survey identifies that record on the ground, or should; whereas, if the survey predetermines the land boundaries, then the record of the title should follow the surveyor's map and dimensions. It is a general proposition that record physical conditions, both monuments and possession, should agree; it is a common fact that the majority of them do not. Whether the record is to be adjusted to fit the possession, or the reverse, is a problem for the owners and the courts to determine; the surveyor's information, properly related to the facts of title, is a basic necessity in such determination.

The permanence of physical monuments defining boundaries is fluid and doubtful for many reasons, whereas the permanence of the record is fixed. Be the record good or poor, its legal monuments are determinable, but the identification of physical monuments in original situ is often difficult and sometimes impossible. Errors in measurement and placement, natural causes, displacements by works of man, and other conditions make the tenure of a monument in original position very hazardous.

The most accurate and satisfactory method of determining the relative positions of physical monuments lies in the use of a coordinate system based upon the national network of triangulation and the State Plane Coordinate Systems developed by the United States Coast and Geodetic Survey. A thorough understanding of the application of such systems and their generous use in fixing the boundaries of land by physical location and references thereto in the records will serve to maintain the integrity of the ground with the record. Any physical displacement can be readily ascertained and corrected through such record.

Standards of Accuracy

Precision of measurement is a definite requirement for any survey standard; the level of accuracy must be sufficiently high to correspond with the tolerances to be achieved; anything less than standard must be gaged by the limits of the particular work to be done.

It goes without saying that superior accuracy is a necessity in title boundary surveys, regardless of the class of land; for who can predict when rural areas may become urban or city property? Many titles have suffered because of "rough" surveys, executed on the theory that the land was of little value; later the land became expensive business property, causing costly resurveys and litigation.

The woeful insufficiency of the majority of maps showing results of land surveys for title, or relocation of boundaries, is a severe indictment against the profession of land surveying. Cartographic maps, lacking dimensions, must of necessity be drawn and reproduced to accurate scale and relation of all their parts and, for their intended purpose, reflect by the scale and topography all necessary data to the limit of their use. On the other hand, a less accurately drawn survey location map must present a complete dimensioning, mathematically correct, to warrant its existence and tell its story. To be a proper report of the survey, it must show full and complete information on ties, monuments, measurements, methods of location, associated boundary areas, record references, meridian, caption, and all other matters necessary for a full understanding of the title and location of property under survey. A lack of any of these items renders the map insufficient and sub-standard.

Argument and discussion as to the standard of accuracy of any work exist without end and frequently to no purposeful conclusion. It must be remembered that a standard, to be effective, must be greater than the immediate need, but not too great to be unapproachable. It must also consider all of the matters which may operate under it.

The Question of Ethics

No standard can be maintained without full acceptance of the subscribers thereto; to that end the question of ethics is essential. The spirit of competition among surveyors is keen and justifiable, but the spirit of co-operation is far more effective in advancing the interests of all and promoting greater efficiency in the profession. The idea that field notes and maps are an exclusive property investment, and that free exchange of information with reference thereto creates a financial loss to the surveyor, is more or less an exploded notion; actual cases of co-operative exchange and public recordation of maps containing full information support this contention. The surveyor has already been paid for the work which he has done and his notes and maps are merely receipts, as it were, for such work. The exchange of data with another surveyor regarding ties or adjoining boundaries will tend to support rather than to deny his own determinations. Likewise it will permit that check so necessary to prevent error and to eliminate differences which might result in costly litigation.

A valuable asset in the creation and support of a standard of practice is the establishment of one or more central bureaus or organizations whose duty will be to collect a complete bibliography of all matters concerning the profession and to distribute desired information to those having occasion to use it.

In summary, any standard of practice for the profession of land surveyors must be basic in form, flexible to conform with the progress of the community, capable of legal support, and subject to the highest and best of ethical treatment.

* * *

Two States Ask Surveys of Beach Erosion Damage

The newly signed federal law permitting use of government funds to finance up to one-third the cost of beach erosion projects brought a request to Governor Raymond Baldwin of Connecticut to urge an over-all study of the State's coastline problems, and resulted in plans for similar studies of lake-shore damage in Ohio.

The Connecticut Beach Erosion Committee, created July 26, is already making a preliminary survey of erosion conditions. Committee members requested Governor Baldwin to recommend that the Beach Erosion Board of the Corps of Engineers make an over-all study and plan correction of the State's erosion problems.

A resolution recommending a $6,000,000 state appropriation for erosion control along Ohio's Lake Erie waterfront was among 14 recommendations adopted at a recent meeting of the Lake Erie Erosion Committee of the Ohio Postwar Commission.—*Engineering News-Record*, September 19, 1946.

Temperature Correction Table for Steel Tapes

By CECIL E. HANSON, *Licensed Surveyor*

The data for computing the table below were taken from Bureau of Standards Circular No. 332, "Testing of Line Standards and Lengths." The Bureau has adopted 68° F. (20° C.) as the customary temperature and the coefficient of 0.00000645 per degree F. at which steel tapes are certified.

The use of this handy table eliminates the repetition of many small computations, thus reducing errors in that respect to a minimum. The correction guide in the upper left-hand corner of the table indicates whether the correction is to be added or subtracted when measuring between fixed points or setting of a given length.

(Based on coefficient of 0.00000645 per degree Fahrenheit)

Temperature ° F.		Distances and corrections in feet									
Meas. (+) Set. (−)	Meas. (−) Set. (+)	100	200	300	400	500	600	700	800	900	1000
68°	68°	Normal									
69	67	0.001	0.001	0.002	0.003	0.003	0.004	0.005	0.005	0.006	0.006
70	66	.001	.003	.004	.005	.006	.008	.009	.010	.012	.013
71	65	0.002	0.004	0.006	0.008	0.010	0.012	0.014	0.015	0.017	0.019
72	64	.003	.005	.008	.010	.013	.015	.018	.021	.023	.026
73	63	.003	.006	.010	.013	.016	.019	.023	.026	.029	.032
74	62	.004	.008	.012	.015	.019	.023	.027	.031	.035	.039
75	61	.005	.009	.014	.018	.023	.027	.032	.036	.041	.045
76	60	0.005	0.010	0.015	0.021	0.026	0.031	0.036	0.041	0.046	0.052
77	59	.006	.012	.017	.023	.029	.035	.041	.046	.052	.058
78	58	.006	.013	.019	.026	.032	.039	.045	.052	.058	.064
79	57	.007	.014	.021	.028	.035	.043	.050	.057	.064	.071
80	56	.008	.015	.023	.031	.039	.046	.054	.062	.070	.077
81	55	0.008	0.017	0.025	0.034	0.042	0.050	0.059	0.067	0.075	0.084
82	54	.009	.018	.027	.036	.045	.054	.063	.072	.081	.090
83	53	.010	.019	.029	.039	.048	.058	.068	.077	.087	.097
84	52	.010	.021	.031	.041	.052	.062	.072	.083	.093	.103
85	51	.011	.022	.033	.044	.055	.066	.077	.088	.099	.110
86	50	0.012	0.023	0.035	0.046	0.058	0.070	0.081	0.093	0.104	0.116
87	49	.012	.025	.037	.049	.061	.074	.086	.098	.110	.123
88	48	.013	.026	.039	.052	.064	.077	.090	.103	.116	.129
89	47	.014	.027	.041	.054	.068	.081	.095	.108	.122	.135
90	46	.014	.028	.043	.057	.071	.085	.099	.114	.128	.142
91	45	0.015	0.030	0.045	0.059	0.074	0.089	0.104	0.119	0.134	0.148
92	44	.015	.031	.046	.062	.077	.093	.108	.124	.139	.155
93	43	.016	.032	.04	.064	.081	.097	.113	.129	.145	.161
94	42	.017	.034	.050	.067	.084	.101	.117	.134	.151	.168
95	41	.017	.035	.052	.070	.087	.104	.122	.139	.157	.174
96	40	0.018	0.036	0.054	0.072	0.090	0.108	0.126	0.144	0.163	0.181
97	39	.019	.037	.056	.075	.094	.112	.131	.150	.168	.187
98	38	.019	.039	.058	.077	.097	.116	.135	.155	.174	.194
99	37	.020	.040	.060	.080	.100	.120	.140	.160	.180	.200
100	36	.021	.041	.062	.083	.103	.124	.144	.165	.186	.206
101	35	0.021	0.043	0.064	0.085	0.106	0.128	0.149	0.170	0.192	0.213
102	34	.022	.044	.066	.088	.110	.132	.154	.175	.197	.219
103	33	.023	.045	.068	.090	.113	.135	.158	.181	.203	.226
104	32	.023	.046	.070	.093	.116	.139	.163	.186	.209	.232
105	31	.024	.048	.072	.095	.119	.143	.169	.191	.215	.239

Landform, Landscape, Land-use, and Land-type Maps

By PROF. ERWIN RAISZ*

THE ABOVE TERMS are used by geographers, with considerable variation as to their meaning. To clarify these terms is important because they represent the most meaningful conceptions which whirl around in the minds of map makers thinking of the fundamentals of their profession. These four terms represent the four basic approaches to making a map.

FIGURE 1.—Japan (part of landform map from E. Raisz).

1. *Landform maps.*—These show the plains, plateaus, mountains, etc., and also the rivers, lakes, and seas which helped to shape them; with one word, the geomorphology of the region, including its hydrography. Map publishers call these "physical" maps, not such a bad term if it would not be contrasted with

Reprinted through the courtesy of *The Journal of Geography*, March 1946.

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"political" maps, which is a reminder of the days when the description of boundaries was regarded as one of the most essential parts of geography.

The cartography of landform maps is relatively simple. For large-scale landform maps we may use contour lines, hachures, plastic shading, or horizontal form-lines, depending on the available surveys. For medium-scale maps (1:250,000 to 1:1,000,000) contour lines with altitude tints give the best results. For small-scale landform maps, we may think of Lobeck's "physiographic diagrams" (why "diagrams"?); or we may use a photograph of a good, uncolored relief model or imitate the result of this with plastic shading. If we use altitude tints only, as many textbooks do, the result is likely to be misleading. Landform maps will often form the bases of the other types of maps.

FIGURE 2.—A landscape map shows the "looks" of the earth and needs to be shown in colors. This gray reproduction of the colored original is a substitute by necessity. A land-type map would be a combination of this and the sequent map, but is too complex to be presented without colors.

2. *Landscape maps.*—These show the "looks" of the earth's surface. If we photograph the earth from a plane vertically on color film and add some lettering to the picture, we have essentially a very large-scale landscape map. This is the most objective method of cartography. Field, forest, roads, and cities are all there. The cartographer did not interpret anything, just added names to the features, and the map has to be interpreted by the reader without the help of the cartographer. The cartographer, however, will have to do some interpretation for medium- and small-scale landscape maps. It would not do at all to make a huge mosaic of colored photographs and reduce it a hundred times (for instance from 1:10,000 to 1:1,000,000). Roads and small rivers would be so microscopic as not to show at all; fields and even cities would be small blurs on the picture. The cartographer will have to design suitable symbols for field, forest, road, and

stream, etc., similar in shape, texture, and color to their appearance on the large-scale photograph. His desire to make features distinctive will induce him to standardize some symbols and use more contrasting colors. For instance, he will paint a rather yellowish lake in blue, and he will differentiate between green wheatfields and green grasslands, but generally he will try to be as objective as possible. This map will be appreciated by airplane travelers and also by the ground traveler who is usually baffled by how differently the map shows the actual landscape, especially in color.

In very small-scale maps the cartographer will select the orthographic projection, or a photograph of a globe, as this is how the earth would *look* to him if he would see it from the heavens. The landscape map will be different for the seasons. There is nothing wrong with this idea, and for certain parts of the world the comparison of paired summer and winter maps would be most instructive. If the cartographer is limited to a single map, he will select the most representative season for each symbol. One's usual conception is for rather green cornfields, and golden wheatfields, etc.

It is not likely that pure landscape maps will be used in the future to a great extent, but any real cartographer should study the problem and should try to prepare some to cross-fertilize his convention-bound methods with the actual truth, revealed so conveniently by the airplane.

FIGURE 3.—A land-use map shows man's activities, mostly production and transportation.

3. *Land-use maps.*—Land-use maps emphasize the relation of man to the landscape. On large-scale maps the maker of a land-use map will show the various kinds of fields, meadows, pasture land, and forest with highly contrasted colors or patterns. He will emphasize roads and railways; in cities he will differentiate between the functional belts, as residential, manufacturing, etc. In small-scale maps he will show the "dominant" pattern (wheat belt, corn belt) and emphasize manufacturing and mining, which, though highly important, do not show

well on a landscape map. He is likely to add symbols, labels, and letters to show the types of products, will indicate shipping routes, and will likely add statistical insets. Mountains and relief will interest him only as far as they influence farming or communications, and sometimes he will omit them altogether. The presence of mountains can be interpreted from the type of culture rather than the other way around.

Land-use maps are highly important—for certain purposes even more so than topographic sheets—and a complete set of land-use maps of all parts of the world is highly desirable. England has a set of mile-to-the-inch land-use maps, but in these only agricultural uses are shown; manufacturing, mining, residential, and recreational uses are just as legitimate parts of a land-use map. The possibilities of small-scale land-use maps are not yet fully explored. These have to be compiled from large-scale maps and they are not yet available.

4. *Land-type maps.*—Each of the foregoing types of maps represents an approach to the representation of the earth. The landform map shows the configuration of land, mountains, and waters; the landscape map shows chiefly vegetation and cultivation in an objective manner; the land-use map approaches the problem from the human view. Is there a chance to combine these approaches into a harmonious unit to express the all-around geographic type of the region? It is not an easy task. For instance, in the Rocky Mountains the landforms will predominate; in the agricultural Middle West the cultivation pattern of a landscape map or an airplane photograph will give most of the answers, while in the urbanized East the economic land-use approach will be the most important. The variety of the features is endless. The cartographer, however, has to use a limited number of symbols to be understood. He will select his symbols so that (1) they will show the land and water forms, (2) they will resemble in line and color the features, and (3) they will emphasize the human importance of the features.

Obviously such a complex task cannot well be accomplished without colors, but how to use them depends on the scale of the map. On a large-scale map the choice is not so difficult. The conventional blue for hydrography and the brown contour lines, perhaps reinforced by plastic shading, will satisfy the landform approach. A combination of tints and patterns showing the various types of fields, forests, and grasslands, as near their natural color as possible, will give the landscape; and a bold symbol system showing roads, railroads, residences, factories, business districts, etc., will emphasize those features which, although small on the map, may be of major importance. The author is not aware that such maps have been made, but the old 1:100,000 Dutch maps of Java, and even the old 1:50,000 Spanish maps, come remarkably close to the ideal.

Small-scale maps present a somewhat different problem. No more can individual mountains and small rivers be shown, patches of cultivation even less. The cartographer has to select and generalize intelligently and try to present the principal type-characteristics of the region. No satisfactory map has yet been designed which would be harmonious yet distinctive, rich in detail yet not overcrowded, and simple enough to be understood.

The coming of the land-type map is inevitable. More and more people travel by air and cannot fail to observe the immense reality of land types. They complain that our present maps do not express the "looks" of the earth well. Colored airplane photographs point the way in which cartography has to travel to keep up with the demands of the Air Age.

The Biggest Telescope in the World*

By ANDREW HAMILTON

The war halted work on an instrument through which men will be able to look 6,000,000,000,000,000,000,000 miles into space, visually exploring eight times as much of the universe as science now knows. With the fighting over, construction of the giant $6,000,000 Mount Palomar telescope and its 200-inch mirror is again in progress in Southern California. By the summer of 1947, the great 'scope will begin its exciting exploration of the heavens.

The 200-inch instrument will be the big brother of the 100-inch Mount Wilson telescope, presently the world's largest; both were sired by the same man, the late Dr. George Ellery Hale. Financed by the Rockefeller General Education Board, it was started in 1929.

The work has involved engineering problems as complex and challenging as building Boulder Dam, the San Francisco Bay bridges, or the Normandie. Stepping up the diameter of the great glass mirror by 100 inches increases its area four times and its weight eight times. The ribbed steel mounting that holds the mirror weighs as much as a Navy subchaser, and the helmet-shaped observatory in which the titanic instrument stands is ten stories high.

But these problems of size are hardly worth mentioning when set alongside the hairsplitting accuracy and watchlike precision required. A railway bridge may safely sag several inches under a heavy train, but the telescope mounting must not deform anywhere or in any position by more than one-sixteenth of an inch. It must be so delicately balanced that the 500-ton steel frame can be moved by a device the size of an electric sewing machine. While a seventeen-foot plate-glass store window may be a half inch out of true and yet be entirely serviceable, the 200-inch telescope mirror must not vary from perfection more than 1/1,000,000th of an inch—otherwise optical alignment is distorted and delicate mathematical computations become worthless.

But the headaches have all been overcome. Today, in the air-conditioned laboratories of the California Institute of Technology, skilled and loving hands are putting the final polish on the huge Pyrex mirror which was originally cast in the Corning Glass Works in New York State and transported west as carefully as though it were a mammoth bubble which at any instant might burst. At the first casting, the disk was as flat as a frozen pond, but now it has been "dished out" so that its curve, if continued, would form a sphere 222 feet in diameter.

When polished to jewel-like perfection and coated with aluminum, the great glass eye will be trucked through the streets of Pasadena to the pines and cedars atop Mount Palomar, 100 miles southeast of Los Angeles and 50 miles north of San Diego. There, on a ridge 5600 feet above sea level, selected from among scores of mountaintop and plateau sites in Arizona and Southern California, carpenters and plumbers and painters are putting the final touches on a community to be devoted entirely to the study of the stars. In addition to the silvery-domed observatory, there are dwellings for the astronomers and their families, smaller observatory housings for the three "pilot" Schmidt telescopes, Diesel-power facilities, a water system and fire protection, radio communication, and an airplane landing field for handy commuting to Pasadena.

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The Co-ordination and Administration of City Surveying and Mapping Activities

By JOSEPH M. DEARBORN*

THE STRENGTH and the weakness of municipal government lies, in large measure, in the administration of its surveying and mapping activities. The effects of good or poor work reach into every phase of civic life. Into the hands of our city surveying and map-making agencies is placed a public trust, far-reaching in its scope and touching the lives of every citizen. It is inevitable that we, directly charged with this responsibility, have a sense of personal pride in our work.

However, the time has come when we must take stock of our good and bad points. The demands for our services increase daily and will continue to do so, and the standards of accuracy required seem also to be increasing. We must be prepared in the future to operate, in every respect, as economically and efficiently as local conditions permit.

To enumerate the credit side of the ledger in municipal surveying administration would serve, at the moment, no specific purpose. It is sufficient to say that all cities have, within their administrative pattern, an overwhelming number of fine programs, ideas, and innovations. It certainly is most useful to point out how we sometimes fall short of the standards we all in some degree desire. The application of remedy, of course, must be preceded by diagnosis.

Perhaps the greatest failing that we might consider in the administration of our technical efforts is the lack, in varying degrees, of co-ordination of our activities. This may run all the way from practically none at all to near perfection. Co-ordination, in the technical sense, has come to mean a great deal to all of us, and yet, in its broader meaning, we seem to be remiss in its application. We can have administration without co-ordination, but *good* administration demands it.

Let us examine the types and sources of demands made upon our city surveyors and mappers. The greatest user of survey and map information is the city itself. Inter-departmental and intra-departmental demands for data constitute a great majority of the daily requests. The flow of these requests, back and forth, is dependent upon how centralized a system is in operation, but generally this traffic is great enough to indicate a serious lack of co-ordination which results in inefficiency and wasted time. From the private engineers, surveyors, and contractors comes the next largest demand for information. It is frequently necessary for them to visit several offices to secure data that unquestionably should be available at one source. The resulting confusion affects public relations and cannot be termed good management. Finally, the general public, who may be classified as laymen, call time and again for information. Often, lacking in technical understanding either of what they are looking for or where it may be found,

Presented at the Sixth Annual Meeting, American Congress on Surveying and Mapping, Washington, D. C., June 28–29, 1946.

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the securing of information is made most difficult for them. This traffic in survey data greatly increases the possibility for both minor and serious error.

It is surely obvious that the correction of these many ills lies in the establishment of a centralized survey and map agency, whose co-ordinated efforts may be directed solely to the preparation and dispensing of survey and map data. The Public Works Department, the Planning Board, the Assessors, the Zoning Board, the Building Commissioner, the Board of Appraisal of Benefits and Damages, the Highway Department, the Police and Fire Department, the Legal Department, the private engineer and surveyor, the contractor, and the general public will all go to one source for survey and map information. Each will have demands peculiar to itself, but by the utilization of standard scales and base maps, a system may be evolved whereby all may be completely satisfied.

Any discussion of the administration of city surveying and mapping activities must invariably bring to light the technical operations whereby data are procured. No two cities in America operate exactly alike in this respect, which is to be regretted. So much poor work is done, here and there, that at times it is alarming. In no scientific field have so many innovations in procedures, standards, and new instruments been developed, and yet the general adoption of these has been exceedingly slow. It can almost be said of some cities that they use nineteenth century methods in the twentieth century.

To correct such a condition will require an intensive educational program. From our colleges and universities, from federal and state agencies, from cities, and from organizations like the American Congress on Surveying and Mapping must flow a constant emphasis on this particular failing and the necessary measures to correct it. To imply that all cities need this advice would be doing an ill service. Many have so improved their techniques and standards as to be consistent with modern practice. By cities such as these the example must be set, and from them must come the "know-how" and the encouragement.

A planned program for urban surveys and mapping is a prerequisite to proper co-ordination and administration. We, whose work is so closely associated with municipal engineering and long-range planning, should not overlook the fact that the results, which we achieve in the name of planning, must have their foundation in an orderly, intelligent process. To administer without a plan is to endanger the entire structure of good government. Much has been said about the accurate, efficient, and systematic development of a good city survey. The program has been tried and found not wanting. The pattern is set; we have but to follow it with slight modification to fit local needs and conditions. From precise control to the topographic survey, the procedures and specifications are designed to fill a city's every need.

Duplication of authority often causes a duplication of work. The survey and map requirements of the different departments, boards, and commissions have many similar characteristics. Each, with full authority, may be engaged in work common to the other, yet no interchange of either data or final results takes place. It is, therefore, very obvious that money and time are being spent most unwisely.

There is but one remedy for this—the assignment of all basic survey and map work to the centralized agency mentioned above. Here, all base maps will be prepared and then sent to the various other agencies for their completion and use. In this way, duplication of effort and possibility for error will be reduced to a minimum. Basic survey and map data will be co-ordinated throughout the city.

Costs, in most instances, will be reduced materially, and the money thus gained can be applied to the improvement of the whole program, to technical standards and procedures, and to the purchase of more modern equipment.

The political, legal, and financial aspects of municipal surveying and mapping activities often bring to the engineer insurmountable problems in administration. To discuss these at great length would require an analysis of the whole city governmental picture. In the course of our work, we must accept the dictates of the majority and do the best we can under the circumstances. However, it is unfortunate that often we must accept the orders of laymen who may know but very little concerning our problems and plans. Lately, the trend has been for people in all walks of life to be more survey and map conscious. Let us hope it continues, for it can result in much good to all of us.

There are, in all of these problems, certain truths which seem to be axiomatic. They offer at least a partial insight into future trends and possibilities. Where political activity is at a minimum, good survey and mapping administration can be and is established readily. Where surveying and mapping have received good publicity, through public education and enlightenment, the problem of securing adequate legislation is not too great. Where public demand and the public good are the motivating factors, financial support for the program may be secured more easily.

Co-operation between cities, states, and the Federal Government on surveying and mapping problems is most essential. In the utilization and obtaining of control surveys, state-wide plane coordinates, river and harbor surveys, vertical level systems, agricultural studies, commerce and industrial information, population and census data, and other engineering data, much good can be derived, for all, by a very active consultation. Too many cities look upon this as an infringement upon home rule. It is hoped that, in the future, we who are engaged in city surveying and mapping can more readily appreciate that our problems are only a part of the total picture.

Personnel problems in municipal surveying and mapping often bring to the administrator difficulties which have their reflection in the quality of work accomplished. Civil service or the merit systems in force in most cities, although admirable in purpose, overlook certain fundamentals and customs. In the old days it was not unusual to employ in the lower brackets, during vacation periods, college-trained men who were, for the sake of practical training, willing to work at a nominal wage. Thus it was possible to secure excellent work at a minimum cost, and our city executives came to look upon this as a set standard, subject to little variation. Other means of training and specialization and the operation of surveying camps by our colleges and universities now deprive our cities of this source of labor. It has been necessary to employ men who lack much in formal education, but who have a willingness to learn on the job plus enthusiasm and interest. These men have family and other responsibilities, yet are obliged to work at a previously set low salary, with very little security, because most of them are unable to meet the standards formerly set by college-trained men. It is inevitable that a certain amount of wage dispute and slackness in the work take place. We cannot expect professional ethics from a nonprofessional employee unless we can make certain guarantees to him.

There is a fair solution to this problem. Perhaps our engineering schools might be induced to set up, as part of their curriculum in surveying and mapping,

a co-operative work venture with the cities in their immediate vicinities. At the same time the city should fill the gaps with untrained men, on a new standard of qualifications and wages, with rigid standards on progress and procedure. In this way, opportunity would be denied to none who are willing to work for it.

At this point you may feel that too much emphasis has been placed on what appear to be common failings in the administration of city surveying and mapping activities. Complacency is a luxury the municipal planner can ill afford. If, in this summary of prevalent ills, attention is called to a weakness in any city's survey program, then corrective steps should be taken on the earliest possible date. Ever mindful of our professional obligation, we should all constantly strive for improvement. In so doing, we set the pattern for others to follow.

In our thought and actions we should work towards an ultimate goal—the establishment of a centralized city survey and mapping agency; the adoption and putting into practice of new procedures and specifications; the development of a well-planned surveying and mapping program; the editing and publishing of intelligent understandable information and news; the elimination of duplication of authority and work; the promotion of consultation and co-operation between agencies at different governmental levels; and the acceptance of a broader understanding of personnel problems. If these can advance the standards and administration of city surveying and mapping, then we are obligated to give them appropriate consideration.

The American Congress on Surveying and Mapping has an obligation and an opportunity to promote the principles of better surveying and mapping throughout the hemisphere. In the field of city surveys, much can be done along this line. We most cordially solicit and invite through the medium of the quarterly journal, SURVEYING AND MAPPING, your ideas, comments, and suggestions. I leave to those of you directly concerned, this challenge: What does the improvement and further development of this field mean to you?

* * *

Richmond City Planning Commission Makes Report

AMONG THE MANY forward-looking plans for city development, the one recently issued by the City Planning Commission of Richmond, Va., deserves special mention. It comprises a most comprehensive and careful study and forecast of the needs of a metropolitan area. Historical background, population trends, housing, transportation, recreational facilities, civic center development, are all covered in considerable detail. Fifty or more tabulations and almost a hundred large charts and graphs supplement this study.

The whole comprises a noteworthy attempt to dramatize the needs and opportunities of Richmond. A number of men have served in developing this fine report, including E. M. Hastings, who acted as chairman of the Commission for a number of years, and the firm of Harland Bartholomew, which served as consultants and technical experts. This 280-page report will be found on file in the Reading Room of the American Society of Civil Engineers and also in the Engineering Societies Library. It will repay study on the part of those interested in civic and district planning.—*Civil Engineering*, September 1946.

Programming Urban Surveys

By MURRAY Y. POLING

SENIOR GEODETIC ENGINEER, U. S. COAST AND GEODETIC SURVEY

NOT long ago a public school was built in one of our communities at a cost of approximately $75,000. It was a modern school; the architect was justly proud of his work, but the local officials were considerably chagrined when they learned the school was in a section where it would require 50 years before enough students would be available under normal conditions to open the school on a reasonable operating basis. Why was this locality chosen for the school in the first place? A construction crew laid a sewer along a street in a Nebraska city—and then discovered two sewers of comparable size already installed in the same street. Who was responsible for laying the first and second sewers and then abandoning them—to all intents and purposes—to disintegrate? In Pennsylvania the owner of an eight-story apartment building was obliged to chisel one-tenth foot off one side of the structure because it encroached on the adjoining property. How is it that such a building was erected without first establishing the correct property lines?

The instances cited are just three of many similar cases that could be mentioned. The answer to these questions lies in the fact that the cities in which these situations arise do not have or have not had community planning based on thorough engineering surveys. The lack of such surveys costs the public untold sums of money each year. In one city alone, more than a million dollars is spent annually on litigation over boundaries and land lines.

Despite these mounting and needless costs, engineers and public officials generally do not recognize the value and importance of basic city surveys, especially in the field of horizontal and vertical control. They are not sold on long-range programming of such activities and prefer to operate on a "hand-to-mouth" basis. In many instances the engineer cannot be entirely blamed. Along with his job he inherits such a conglomeration of confused, inadequate, or obsolete surveys that it is natural for him to take the line of least resistance and to adhere to the policies and practices of his predecessors, justifying such action on the basis of "lack of funds," "not sufficient time," or that "a survey program is not necessary."

Such objections are not believed to be entirely because of the element of time or the lack of funds. One real reason may be that the engineer lacks the specific technical training or experience; or that the information needed to carry on adequate control surveys was not readily or properly brought to his attention. Another valid reason might be one that Dr. A. R. Stevenson implies in his article, "Technical Education Plus the Humanities Makes a Better Engineer," published in the January–March 1946 issue of SURVEYING AND MAPPING. Dr. Stevenson says: "A technical education has to do with *things*. Employees at the bottom of any organization deal with *things;* those at the top deal with *people.*" Obviously, an engineer with an ambitious program for engineering surveys cannot put it into effect unless he can persuade the city government to furnish him the necessary funds.

Presented at Sixth Annual Meeting, American Congress on Surveying and Mapping, Washington, D. C., June 28–29, 1946.

Essential Elements of an Urban Survey

Many engineers and surveyors, in private practice or concerned with the work of local governments, are familiar with what is intended in the term "city survey," but the opinion seems to be growing that such surveys include only triangulation, traverse, and levels. Although these basic controls are invaluable, they are merely the foundation of the engineering survey system and rightly belong in the number one group in the sequence of operations. Considered comprehensively, the city survey consists of a group of engineering surveys, studies, maps, and charts which are essential in administering the public business in the most efficient and economical manner. I emphasize the *most economical manner*, for without the use of such basic information throughout an area, over-all economy cannot be obtained because piecemeal operations must be substituted and such operations can only result in making the supplemental surveys a capital expense year after year.

The group of engineering surveys and studies of an average urban area should include:

1. Basic control surveys
    - Triangulation
    - Traverse
    - Levels
2. Topographic surveys and maps
3. Restoring and monumenting boundaries
    - Section and public land lines
    - Urban
    - Highway, road, and street
    - Block and lot
4. Underground and surface utility structures surveys
5. Wall or base map
6. Property identification and tax maps
7. Land-use maps
8. Geologic surveys
    - Bedrock surfaces
    - Stratigraphy
    - Resources
9. Soil surveys
10. Cross sections and profiles
11. Surveys and plans of existing public buildings
12. Traffic surveys and studies
13. Transit and transportation studies
    - Facilities and uses
    - Special features
14. Riparian, stream, and hydrographic surveys and charts
15. Climatologic and meteorologic studies
16. Resources

In programming surveys the sequence of operations is highly important. Although local conditions and information already available may require a deviation from the order mentioned, there should be no fundamental change, especially in regard to the first four items.

1. *Basic control surveys.*—The triangulation, traverse, and levels form the basic framework for the urban survey structure, but it is generally in these three items that our cities are lacking, and especially the first two. An immediate reason for this is that the greatest interest of the city engineering staff is in the supplemental surveys which follow the establishment of the horizontal and vertical framework. This is logical because of the kinds of information required in carrying on the day-to-day business of the local government, but it is not desirable from the planning and programming points of view, as these controls facilitate all other survey operations.

2. *Topographic surveys and maps.*—It is not necessary here to mention the various uses and over-all value of the large-scale topographic map. It is a "must" for all urban areas, and the preparation of such maps by photogrammetric meth ods is advancing rapidly. Because of the magnitude of the job yet to be done, it is hoped that this method may be satisfactorily perfected for urban use at an early date.

3. *Restoring and monumenting boundaries.*—Accurate determinations of the positions of property and land boundaries and the restoration of boundary markers constitute one of the most important phases of the urban engineering survey program. This alone would eliminate most of the costly litigation previously mentioned. Field surveys are the base upon which the legal descriptions of property are prepared; therefore the results of such surveys should be preserved both in the field and in the public record. It is true that this has been the attempted general practice—but without the benefit of precision control. Although of sufficient importance and magnitude to be considered as a major phase of engineering surveys, restoration and preservation of property boundaries appear to be more appropriately considered as merely putting into practice the accurate horizontal controls established by the geodetic survey. The amount of work to be done in this field is practically unlimited considering that state, county, township, section, highway, road, street, and other public boundary lines are affected.

4. *Underground and surface structure surveys.*—Although the value of maintaining accurate records of underground and related surface utility structures is generally recognized, the pertinent surveys and records have been neglected for years in many urban areas. These are highly important as they affect the construction and maintenance of capital improvements and include items that affect the life and health of the community. This type of work represents another major use that should be made of the horizontal and vertical controls. Such surveys should be performed over the entire area involved, rather than confined to serving the immediate needs of a specific construction operation.

5–16. *Other surveys in urban group.*—Each of the other items mentioned in this group has its respective place in the engineering survey program and is important in carrying on the day-to-day business of local government. However, a number of them may be said to be unilateral in scope and do not have the broad relative values which are contained in the control surveys and basic maps. Some of these surveys and studies serve a specific need but, irrespective of the results, have little effect upon the over-all economy of the community.

Property Assessments and Urban Surveys

It is true that property taxes and assessments will be made against real prop-

erty without the use of precision horizontal control surveys. In fact, it is common knowledge that some properties are assessed on an area basis where the surveys used to determine the areas are known to be grossly in error and the valuation merely a unit of comparison, which was established by a predecessor in office on the basis of "guesstimation." Some properties are not even listed on the tax rolls, while others are assessed in one section or county and the geographic location of the property is actually in another, such as was found in the area of Raleigh, North Carolina, as well as some of the larger cities of the North. So on the basis of past operations in the United States, with respect to taxation of real property, precision surveys are not a selling point to property appraisers. In other words, precision surveys appear to have little weight in the appraisal of property. However, looking at the relative values of precision co-ordinated surveys to the assessment of property, we know that property cannot be misplaced or left out of the tax rolls. It is also true that in the use of a coordinate system based on precision control, the property owner is assessed on the amount of property he actually owns. In addition, any subsequent tax survey or appraisal is facilitated by the information made available with respect to the preserved positions of the street lines.

Urban Surveys are an Area Problem

Most engineering survey problems in the urban areas are not necessarily confined to a single street or block but affect an entire area. The determining of a street boundary, for example, may appear to be merely establishing the local boundary lines, but such a survey usually affects other street boundaries and may revise the boundaries of private property and affect the location of public utilities, buildings, etc. If a city were not considered as a unit area, there would be no municipal limits—but we do have these boundaries and we do not build walls along them to limit expansion or to keep the rest of the world out. So the effect of engineering activities may extend far beyond the existing corporate limits. Thus we find that the activities in urban areas extend or overlap into the counties, the counties into the state, and so on into adjoining states. The sooner it is recognized that urban surveys are an area problem, the sooner engineering surveys will be executed with a full realization of their relative long-range values, as well as to satisfy day-to-day needs.

Responsibilities of the Federal Government

It is the function of the Federal Government to establish the basic horizontal and vertical controls throughout the country for mapping purposes and general use. This does not place upon the Federal Government the responsibility for establishing a spacing of stations which would be adequate for all purposes within a municipality, county, or state. The federal responsibility, however, should include a sufficient breakdown or spacing of stations to enable convenient ties to be made to the federal network and to facilitate the establishment of local triangulation. This is especially true with respect to the horizontal control and can be readily accomplished in the reconnaissance by giving full consideration to the local conditions.

Another responsibility which has always been accepted by the federal agencies, upon request, is to recommend to municipalities, counties or states, the type or design of control needed. In a number of instances, consulting services have been

provided such as in Cincinnati, Rochester, Boston, Minneapolis, Baltimore, Worcester and others, to recommend procedure and methods, and assistance has been rendered in the final adjustments of the local work.

Responsibilities of the State

In addition to the responsibilities of a state with respect to education, professional licensing, adoption by legislative acts of rules or regulations affecting surveying and mapping and the related fields, the further breakdown of the federal control suitable for state-wide use should be recognized as a state responsibility, not necessarily as an operating agency, but at least from the educational and promotional viewpoints. Several states such as Alabama, Connecticut, Florida, Georgia, Louisiana, Massachusetts, North Carolina, Oklahoma, and South Carolina, have recognized the need and established local control through the cooperation of the federal and state agencies during the federal work programs. The states, in my opinion, should encourage the establishment and use of local control, and should correlate the needs of the state agencies and the public utility companies with regard to the federal mapping program.

Responsibilities of the Local Government

The major responsibility for establishing local horizontal and vertical controls, the execution of various types of engineering surveys, and the preparation of large-scale maps rests with the local governments in the municipalities. The greatest need for basic and supplemental surveys and maps is within these areas where the larger percentage of the people live, and, in general, the most valuable property is situated. The local governments are responsible for the administration of the public business within the corporate limits and have specific jurisdictional control within the areas adjacent to these boundaries.

Many of those in authority in local government recognize the need for surveys, maps, and studies relative to the average operational problems or activities, but they do not wish to accept the responsibility for recommending long-range programming of surveys or to solicit funds to finance those items of basic importance. Some of these survey items appear to them as intangibles not warranting serious consideration, except as needed to satisfy immediate construction operations. Frequently, the reason for this is a desire to secure credit for the current local regime by constructing projects that are outwardly more impressive. The basic studies and surveys are given too little credit for their long-range value. In some instances, the local survey programs consist of only the physical items affecting the specific structures proposed, with little bearing on the community plan.

Education for Urban Surveys

The members of the American Congress on Surveying and Mapping and other technical organizations have a great deal to do with shaping the future of programming engineering surveys in urban areas. It is not merely a problem for the surveyors or engineers who execute or direct the work in the field, but it is an over-all problem of educators; local, state, and federal agencies; private practitioners; technical societies and scientific organizations; and international organizations where an interchange of ideas, methods, and procedures are being effected in the over-all cartographic field.

This Congress can accomplish much by the dissemination of information through the medium of the publication SURVEYING AND MAPPING but that is not sufficient. The activities of the Technical Divisions are essential if progressive action is to be undertaken. Recently an Interim Committee on Municipal and County Engineering Surveys has been formed which has the responsibility of bringing to the readers of SURVEYING AND MAPPING all possible information relative to urban engineering surveys. I believe this is an excellent step in the right direction and it offers a medium whereby controversial opinions may be expressed.

IMPORTANCE OF URBAN SURVEYS TO THE NATION

According to the 1940 census approximately 57 percent of the people in the United States live in the cities. In the city areas, surveys and maps concern the health, safety, and general welfare of the people. Such surveys provide a medium of facts and figures upon which the development of the community may be economically and systematically planned. The standards by which these engineering surveys are executed should reflect the specifications accepted by the surveying profession so that the maximum use may be made of the information.

All cities having a population of 5,000 or more should have, in my opinion, a long-range survey program. Both the horizontal and vertical controls should be established as soon as possible and should be executed on the same principles which govern such work in the larger cities. This does not necessarily imply that every city of 5,000 population should have triangulation, traverse, and levels all of first-order accuracy. In some instances, the horizontal control could be established by traverses without the use of local triangulation stations. Such traverses, however, should be tied into the federal network of triangulation and based on the State Plane Coordinate Systems established by the Coast and Geodetic Survey.

I believe that the basic traverse control for the small cities should be of first-order accuracy because this accuracy will satisfy all future supplemental surveys and the increase in property values. The difference in costs for establishing first- or second-order accuracy is not appreciable. The entire cost of establishing control systems for the small towns is not believed to be out of reach of the local governments.

It is true that many of the small urban areas do not have adequate engineering staffs with which to perform the work and usually employ a part-time engineer or surveyor as the need arises. However, all of the work pertinent to the basic surveys need not be planned for completion within a specific period of time but may be executed in proportion to the amount of funds available. If piecemeal operation must be done, because of financial or other reasons, then why not do it with full consideration for the maximum benefit to be obtained when the work is completed? With this method of operation in those areas which may have a manpower shortage, as well as the problem of financing the work, we would be striving toward a common goal, that goal in the urban areas being the establishment and use of local horizontal and vertical controls; the adoption and use of the State Plane Coordinate Systems; the preparation of large-scale topographic maps of the entire area; the designation of property boundaries by co-ordinated positions, and the up-to-date survey and mapping of the underground and surface utility structures. With this information available all supplemental surveys will be facilitated, and the surveying and mapping activities can be considered as a public asset.

Co-ordinating and Administering Federal Surveying and Mapping Activities

By ROBERT H. RANDALL*

THE subject on which I am to speak deals with the co-ordination and administration of surveying and mapping activities in the Federal Government. Before going too deeply into the subject, I should like to trace a little of the history back of our present efforts in this direction.

Historical Background

As most of us know, we have been discussing—and I think it is fair to say fussing—for more than 100 years about how the surveying and mapping affairs of the Federal Government might be organized on a better basis. During that time there have been some 17 official investigations and reports made by committees appointed either by the President or by the Congress. Of the 17 reports, something like a half-dozen were outstanding, in that they really delved into the subject. In these the principal finding was that two elements necessary to better mapping progress were lacking. In the first place, there was no general understanding, no over-all program of what needed to be done. Secondly, there was no co-ordination or integration of production efforts. So, these half dozen or so reports jumped to the conclusion that what was needed was a new unit in the federal structure, to provide for these two missing elements. They recommended, in various terms and in varying degrees, that there be set up a new, consolidated surveying agency, and hoped thereby to achieve unity of program and production. In so doing they overlooked the fact that consolidation in itself may not be the best organizational procedure, and that to give one agency, no matter how well intentioned, a monopoly on surveying and mapping is not necessarily the best way to get adequate service and economy.

That was the situation until 1940 when, in connection with the presidential plan of governmental reorganization, the Bureau of the Budget went into the problem again. The conclusion resulting from the Bureau's study was that the main objective should be service, and that, so far as possible, the whole matter should be looked at from the map user's standpoint. From this it followed that although the form of organization for producing the various kinds of maps and charts was important, its importance lay in its capacity to render service—to deliver the various kinds of maps and charts which the map users of the nation need with all possible promptness of delivery, satisfactory quality, and economy.

Co-ordinated Program Set up by Bureau of the Budget

In following out this idea, the Budget study recommended that consistent, continuous attention be directed to (1) programming, and (2) co-ordination of all federal map production activities. Pursuant to this recommendation, the Bureau, in respect to programming, requests each federal department or establishment that is a large user of topographic or planimetric maps to conduct a

Presented at Sixth Annual Meeting, American Congress on Surveying and Mapping, Washington, D. C., June 28–29, 1946.

* Chief Examiner, Surveying and Mapping, U. S. Bureau of the Budget.

continuing analysis of its map needs; and, from these advices and in consultation with representatives of the agencies concerned, it prepares annually a program outlining where and when such map information should be available to map users. This program covers the next fiscal year, and at least 5 years thereafter.

This program is then used by the Geological Survey, the Coast and Geodetic Survey, and other federal producers of surveying and mapping information which contribute to the production of maps of this class, as a basis for their requests to Congress for appropriations. After these requests are received, the Bureau, in consultation with representatives of these producing agencies, considers them in their relation to each other and to the proposals for appropriations for all other classes of maps and charts, such as hydrographic charts, aeronautical charts, geologic maps, soil maps, etc. Upon the basis of all this information, it prepares its recommendations to the President and Congress.

The setting-up of a co-ordinated program is, of course, the first and indispensable step in co-ordinating production activities. Given such an over-all program, the next step is to provide for its effectuation. Proper results in this are to be measured in terms of quality of final results, delivery of the product in time to be of use, and economy. Toward these ends, the Budget has established, in co-operation with the producing agencies, a uniform, skeleton system of accounting of operations, both in respect to progress made and costs resulting. Thus the agencies producing topographic and planimetric maps and the agencies reproducing and publishing these and other maps and charts keep uniform accounts, and are on record and able to give full accounting of their stewardship for the parts of the public business placed in their charge. The quarterly reports which each prepares are available to the other agencies concerned and, since the items reported are in a common language and in mutually understandable terms, they form the basis for the study of technical and administrative improvement. By studying them, the producing agencies may pool their experience. New methods and equipment developed by one may be examined and, if shown to be successful by the record, adopted by all.

A further advantage of the uniform accounting procedure is in the obvious fact that it indicates, objectively, the relative efficiency of the agencies participating. Despite the 17 official studies of surveying and mapping in the Federal Government, no significant shifting of responsibilities or major consolidation thereof has ever occurred. Always these, when presented to Congress, were recommended on the basis of the opinions of the experts making the report. As opinions, they were attacked by the agencies involved, which had opinions of their own. The record of performance and costs, which is now and for some years past has been accumulating, forms the best possible basis for effecting any future changes in the Government's mapping organization, should such appear to be needed.

So much for a statement of the general procedures now employed for programming and co-ordination, and consequently improvement, of production. There are, of course, specific problems to be met. One of these I shall try to indicate briefly. It relates to the measures to be taken by producing agencies to increase total efficiency.

Need for Over-all Economy

In every private business, organized for profit, the head of the business always

has a very plain motive for striving to constantly increase efficiency of operation. Operating at an efficient level means more profits. Although he may have a very real interest in the technical methods employed in the various steps of the total procedure necessary to produce the product or service which is to be delivered, his real concern is that the total cost for the whole operation shall be as low as it is possible to make it. In the public service the drive for over-all economy is not always present to an equal degree. In the operations of the federal agencies, including those producing maps and charts, there is sometimes a tendency for the directing head to allow himself to become interested in and satisfied with improvements in the techniques and processes in the various separate steps of the total operation, thereby in some degree losing sight of the necessity for total economy. The chief of each unit or section is concerned with improving his particular step in the process, for by so doing he may expect to advance in status and in salary. But the big boss is not always able to get advice to the effect that perhaps a certain step, or number of steps, could be cut out entirely.

Realizing this, the heads of some of the federal producing agencies have recently placed more emphasis on practical staff organization to increase total economy. In such organizations it is now some one person's job to see to it that not only are the processes and equipment used in each step of the work the best that are available at the time, but that the total operation from start to finish is accomplished in the shortest and most direct way possible. In such an agency, efficiency and resulting economy are sought by directing attention to two principal matters. On the one hand there is what might be called the management function, involving the programming of operations and the lay-out and follow-through of the work of production. On the other hand, of course, is this specific attention to methods, and the drive for not only efficiency in the component parts, but economy in the total operation. And methods, by this definition, are now receiving as much attention as management.

International Cartographic Activities

In addition to this brief recount of our efforts toward better programming and improved production in federal mapping, concerned for the most part with domestic areas, I should like to make some mention of our participation in international cartographic affairs. In respect to the American Nations, there is, as you know, a Commission on Cartography, set up by the Pan American Institute of Geography and History. The United States and the other nations that make up the Hemisphere are actively joining in the efforts of this Commission to bring about complete understanding and co-operation in the advancement of surveying and mapping. We have a lot to learn from the other nations—the Latin American nations and Canada—a lot that we can gain by visiting back and forth, meeting with them, corresponding with them, and working with them. Working with them includes not only association in technical meetings, toward the improvement of methods, agreement on more uniform standards, etc., but actual joint operation of surveys in areas which are near boundaries, or are otherwise of mutual interest. Such co-operation has increased until now it is a real factor in American mapping progress.

During the war, about all we could do was to associate ourselves with the other nations in the American Hemisphere. Now, however, it is hoped that this same kind of co-operation in cartographic matters may be extended to other nations.

In this connection I should like to mention very briefly the steps that have been taken, in the United States, to bring about the proper kind of cartographic organization in the United Nations. Beginning last November, the United States Advisory Committee on American Cartography, which was set up to participate in the work of the Commission on Cartography in the American Hemisphere, joined together with the National Research Council and the American Council of Learned Societies, and had discussion meetings to consider these problems: What are our national interests in surveying and mapping progress beyond our borders, even beyond the Hemisphere? And, what should a world organization like the United Nations do about it?

Out of these discussions has come a proposal. It is now before our Department of State, presumably to be transmitted to the United Nations. This proposal is two-fold: First, that in the General Secretariat of the United Nations there be an adequate cartographic staff to evaluate existing map information, to perform logical cartographic activities for the United Nations itself, to assemble a map library, and to act as a clearing house for map information. Second, that a study group representing leading nations be appointed by the United Nations, to work out the details and procedure for stimulating surveying and mapping, co-ordination of mapping activities, advancement of the science of cartography, etc.

Now that people in the United States and people inside and outside of the Government have participated in these talks, we think the time has come for the United Nations to invite representatives from the other principal nations to sit down, take our ideas as so far developed in the United States, and their own, and see whether or not an international advisory group should be set up to correlate, to improve standards, and to encourage co-operative mapping programs and advance planning in the various nations. And, of course, ever and always to realize that a good part of the 50 million square miles of land area on the planet are not only unsatisfactorily surveyed but not surveyed and mapped at all. This whole subject, it seems to us, should be discussed. It ought to be the sort of thing that the United Nations should be interested in.

(EDITOR'S NOTE.—A resolution endorsing these proposals was approved by the Congress at its closing session and is published on page 265 of this issue.)

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Community Planning To Be Set Up in Canada

A COMMUNITY PLANNING Association of Canada is to be set up by representatives of the Dominion and provincial governments and other organizations, under the auspices of the Central Mortgage and Housing Corporation—federal government housing agency. The object is to foster public understanding of community planning, and to stimulate active participation.

C. D. Howe, Minister of Reconstruction, said that first requirements are accurate topographical and population surveys. He pointed out that during the war the number of industrial workers in Canada doubled and that this has had the effect of increasing the size of industrial areas disproportionately to other parts of the country.—*Engineering News-Record*, September 5, 1946.

Federal Surveying and Mapping Agencies

This is another in the series of sketches of the history, purpose, and scope of activities of federal agencies engaged in surveying and mapping.—EDITOR.

THE U. S. LAKE SURVEY OFFICE
War Department

HISTORY AND DEVELOPMENT

THE SURVEY of the Great Lakes received its impetus, like most matters of its kind, from a need for data that exceeded possible provision by private or local interests. The basic need, of course, was some practical means of low-cost transportation for surpluses in commodities developed in the interior of the country. Local interests provided the Erie Canal which was opened in 1825, but charting the lakes and connecting rivers was complicated by the existence of numerous political boundaries. This hurdle was overcome when Congress passed a bill in 1841 appropriating funds for a "Hydrographical Survey of the Northern and Northwestern Lakes."

The Act designated the Corps of Topographical Engineers to perform the work, and they organized the United States Lake Survey Office in the same year. Except for consolidation of the Topographical Corps with the Corps of Engineers in 1863, the office has operated without change since its establishment.

The area to be covered was so vast that reconnaissance amounted to an exploration. Work was started, nevertheless, with such modest means as were available, and by 1852, a considerable portion of Lake Erie was surveyed. Three charts on Lake Erie were published in that year. Surveys for these charts were carried to a depth of about 16 feet and, as additional data were collected, the choice of this depth was substantiated as being adequate for the remainder of the work.

The east-west expanse of the Great Lakes basin was so great that charts, to be free of cumulative error, had to be prepared with due regard for curvature of the earth. A network of high-order triangulation was started as early as possible and extended across the basin. The hydrographic surveys were conducted at the same time as the small amount of shoreline topography. The latter consisted of a mere fringe along the shore, and was obtained by sketching in connection with chained traverse. Hydrography and topography were plotted on the same sheet, generally at scales of 2 inches and 4 inches to the mile. Little deep sounding was done until modern times.

Outfitting a survey crew in those early days seems a curious undertaking today, when modern communications will bring forth anything desired on a moment's notice. Tally sheets, if available today, would show catnip, arnica, sassafras, and other peculiar items. Imagine a party chief today spending government money for "whiskey spirits" to combat swamp fevers. We may smile

Prepared in the Office of the U. S. Lake Survey, Detroit, Michigan.

at the customs of those days, but we must admire the men selected for the work. The surveyors were required to possess a profound knowledge of their work because they were on their own resources after leaving the starting point. They had to be navigators, astronomers, doctors, engineers, and weather prophets.

The slow process of casting the handlead and line was stimulus for development of the slender wire heavy-weight sounding machine into form suitable for their use, so they were inventors too. As used by the Lake Survey, soundings can be taken with this device without stopping the boat, for it is necessary to raise the weight only a few inches off the bottom in order to be ready for the next sounding. Similarly, and much later, the long-wire sweep became a Lake Survey invention. Both these instruments now are listed as standard equipment in most

CATAMARAN USED IN HYDROGRAPHIC OPERATIONS

texts on surveying. The first portable metal triangulation tower, a structure of iron pipe members, was developed by the Lake Survey also; time and progress protested against laborious lumbering operations to build a tower, only to be abandoned after a few observations.

The necessity for hydraulic as well as hydrographic study of the lakes was soon apparent to those early engineers. Their observations indicated that the Great Lakes were perfectly balanced by nature; that is, the normal rainfall exactly compensated for the outflow. It was obvious that any attempt to deepen the connecting channels without providing compensating outflow restrictions would result in lower lake levels, and correspondingly shallower harbors.

The electric recording current meter was conceived and developed on this project as an aid to gathering the hydraulic data essential to maintaining naviga-

tion. In course of time the multiple meter method for stream measurement was developed, as was also the theory of percentage current velocities.

Recognition of the need for controlling the lake levels placed with the Lake Survey Office the responsibility for hydraulic analysis of all works in and around the Great Lakes. Compensation works, conceived or approved by this office, have made possible deepening the connecting rivers to 27 feet. The controlling depth for navigation varies slightly, however, as the seasonal rainfall may vary. In seasons following extreme low rainfall, drafts exceeding 20 feet may be unsafe.

The desirability for safety is revealed in the records of the Lake Carriers' Association. They reported registration with them in 1944 of 659 cargo carriers capable of transporting nearly 4½ million tons on a single trip. Actual count showed passages in front of the City of Detroit at the frequency of one cargo vessel every 19 minutes throughout the 1944 season. Total bulk freight commerce for that year amounted to more than 184,000,000 net tons. The improvement necessary to movement of this tonnage required many years of effort, and many desirable improvements are still in the planning stage. Few of them could be undertaken until completion of the original survey.

Completion of Original Survey

Limited funds, fickle weather, and hardships delayed the work in those days, just as now. The original survey was completed in 1883, 42 years after the start. It was not until the end of the survey that complete factual data were available. It was then that the shortest sailing courses were established. In 1898 river channels were first measured, flow quantities determined, etc.

Some of the areas involved (in square miles) are as follows: Lake Superior—31,820; Lake Huron—23,010; Lake Michigan—22,400; Lake Erie—9,940; and Lake Ontario—7,540. The total water area, including connecting rivers to Ogdensburg, New York, is 95,260 square miles, and the total land area of the drainage basin is 202,840 square miles.

It is readily understandable that resurveys were in order before the original survey was completed. Growth of agricultural and industrial areas has multiplied navigational requirements and added to their complexities. The figures of the Lake Carriers' Association do not include the many independently operated vessels, the fishing fleets, nor the thousands of pleasure craft that ply the lakes. The Lake Survey has to keep pushing in order to keep abreast.

Survey Methods and Published Charts

The field work is co-ordinated under one branch of the office so that proper regard may be given to all its phases. There are at present three launches of about 50 feet and one 350-ton steamer employed in the work. A launch and party are continuously occupied with revising and correcting the harbor charts and charts of the connecting rivers. A second party conducts the inshore work, i.e., surveys the shallow waters. A third party devotes its time to discharge measurements, and the steamer is used for deep-sea work. Position fixing is done principally by sextant location from shore objects or triangulated survey buoys, but with present rapid strides in knowledge of radar positioning of ships, this method is expected to be largely superseded. Echo sounding has been in use by the Lake Survey since 1928, and at present all vessels are equipped with supersonic sounding equipment. Magnetic studies, water temperature investigations, and re-

lated activities are conducted along with the surveys. Parties are employed ashore as needed for horizontal and vertical control and for topography. The latter extends in general about one-half mile back from the shoreline, and its details are supplied largely by well-controlled aerial photographs.

At the present time 128 charts have been prepared on the polyconic projection at scales ranging from 1:1,200,000 to 1:5,000. In general, harbor charts have scales up to 1:30,000; river and coast charts, to 1:120,000; and general charts, to 1:1,200,000. For catalog and identification purposes general charts bear one-digit numbers, river and coast charts two-digit numbers, and harbor charts three-digit numbers. This system of numbering indicates the locality of the chart, as well as its relation to other charts of the same region on different scales. An annual bulletin is prepared describing in detail landmarks, wrecks, and aids and obstructions to navigation. A monthly supplement to this bulletin giving current changes is issued during the sailing season. Still more charts are planned, and still more work is to be done. Lake Champlain and the New York Barge Canals (lying to the east of the Great Lakes) have been added to the project, as well as Pigeon River and the International Boundary waters to Rainy Lake and Lake of the Woods, lying to the west.

The personnel of the Lake Survey Office are justly proud of all that has been accomplished, and they look forward with keen anticipation to the tasks ahead. They have several studies in progress now that point to continued improvement in the service.

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Civil Service Classification of Engineers Revised

CLASS SPECIFICATIONS for professional engineering positions have recently been revised by the U. S. Civil Service Commission. Outstanding accomplishment of the new criteria, which have become a part of all U. S. Civil Service classification books, is the clarification of educational requirements for appointment to federal civil service positions.

The more detailed statement thus presented clearly differentiates between "professional," "subprofessional," and "positions associated with engineering." In the "professional" bracket, the specification cites duties requiring "(1) the practical application of basic scientific principles, particularly those of higher mathematics, physics, and chemistry; (2) an intimate knowledge of the fundamental engineering concepts and terminology, all the units of measurements, and their inter-relationship common to all branches of engineering; (3) a thorough understanding of engineering techniques as can be gained through 4 years of engineering training in a recognized college or university, or training equivalent in type, scope, and thoroughness."

Included as typical examples of "subprofessional" positions are draftsmen, detailers, instrumentmen, engineering aids, and inspectors. Still further definition is given to "positions associated with engineering but which are neither professional nor subprofessional." Such positions according to the criteria "do not require an understanding of the physical, mathematical, and specialized engineering sciences fundamental to professional engineering." Examples given of this last category are construction foremen, expediters, purchasing agents, and accountants on engineering projects.—*Civil Engineering*, July 1946.

Surveying and Mapping News

Members are requested to send in surveying and mapping news items for publication in SURVEYING AND MAPPING.—EDITOR.

CURRENT SURVEYING AND MAPPING LITERATURE

MAGAZINE ARTICLES

PHOTOGRAMMETRIC MAPPING AND THE WAR. Talbert Abrams, *Papers of the Michigan Academy of Science, Arts, and Letters,* vol. 30, 1944–45.

SPHERO–METRIC NAVIGATION FOR OUR AIR AGE. W. F. Hiltner, *U. S. Naval Institute Proceedings,* January 1946. (Describes the Navigator-Sphere—a calculating machine for solving problems in celestial navigation. Gives latitude and longitude directly from simultaneous star altitude sights.)

MAP PROJECTIONS AND THE GLOBAL WAR. Erwin Raisz, *The Teaching Scientist,* January 1946. (Discusses some of the advancements made in global cartography in recent years.)

IS CLASSIFICATORY APPROACH THE BEST FOR MAPS? Marie Louise Prevost, *Library Journal,* January 15, 1946. (Concludes that a dependable, systematized method of alphabetical subject heading is preferable to a classed catalog.)

PERIOD ORNAMENT, WRITING, AND SYMBOLS ON MAPS, 1250–1800. Edward Lynam, *The Geographical Magazine,* January 1946.

THE STATUS OF TOPOGRAPHIC MAPPING IN NEW ZEALAND. Kenneth B. Cumberland, *The Geographical Review,* January 1946.

THE MAP OF HISPANIC AMERICA ON THE SCALE OF 1:1,000,000. *The Geographical Review,* January 1946. (Condensation of this article appeared in the April–June 1946 issue of SURVEYING AND MAPPING.)

EQUAL–AREA PROJECTION ON THE ICOSAHEDRON. A. D. Bradley, *The Geographical Review,* January 1946. (Describes the construction of an equal-area world map using a cylindrical equal-area projection for projecting on to the faces of the icosahedron.)

ON A VISIT TO VARIOUS U. S. MAPPING AGENCIES. R. D. Davidson, *The Canadian Surveyor,* January 1946. (A résumé of the instruments, methods, and equipment used by some of the governmental and private mapping agencies.)

THE MONOSCOPE. George R. Sonley, *The Canadian Surveyor,* January, 1946. (A simplified instrument designed for use in forest work for changing the scale of an aerial photograph to the scale of the map so that information may be transferred from one to the other.)

THE NEW STANDARD RADAR CAMERA FOR USE BY THE U. S. ARMY AND NAVY WITH AIRBORNE AND SHIPBOARD RADAR INSTALLATIONS. R.

H. Bailey, *The Canadian Surveyor*, January 1946. (A special camera for photographing radar images from the radar scope to give a continuous, permanent record.)

A SIMPLIFIED METHOD FOR DETERMINING THE TRUE AZIMUTH OF A LINE. T. F. Hickerson, *North Carolina Engineer*, January 1946.

SURVEYING AND CONTROLLING DIAMOND-DRILL HOLES. Arthur B. Yates, *Mining Technology*, January 1946. (Describes some of the instruments and methods used in surveying and controlling diamond-drill holes.)

SOME PROBLEMS INVOLVED IN THE INTERPRETATION OF DIAMOND-DRILL-HOLE SAMPLING AND SURVEYING. John J. Collins, *Mining Technology*, January 1946. (Describes deviation and surveying of drill holes and discusses possibility of using oil-well techniques in small diameter holes.)

COMPUTATION OF DISTANCES OF LONG ARCS FOR RADIO PURPOSES. J. H. Cole, *Empire Survey Review*, January 1946. (Concludes that the line of intersection of the spheroid with the plane containing the normal to the spheroid at the sending station and the receiving station is the most probable line required and derives formulas for its computation.)

THE MILLIONTH MAP: ON ITS SCALE THE SUN IS ONLY 93 MILES AWAY. Joan Murchison, *The Pan American*, January 1946.

THE DIAGNOSIS OF COMPASS DIFFICULTIES. (In two parts.) W. E. May, *The Nautical Magazine*, January and February 1946. (Enumerates some of the causes of compass trouble, and how to correct them.)

MICROWAVES ON THE WAY. Harland Manchester, *Scientific American*, January 1946. (Describes some of the applications of microwaves during wartime and their possibilities for peacetime use.)

S. 1720. *Science*, January 11, 1946. (Contains the complete text of the "National Science Foundation Act of 1945.")

IDEALISM FOR THE EMBRYO ENGINEER. L. H. Berger, *Civil Engineering*, January 1946. (War and postwar years seen as offering a great variety of opportunities for self-improvement.)

OREGON GEOGRAPHIC NAMES: II; ADDITIONS SINCE 1944. Lewis A. McArthur, *Oregon Historical Quarterly*, March 1946. (Supplements "Oregon Geographic Names" published by the Oregon Historical Society in 1944.)

THE PLANNING OF AERIAL PHOTOGRAPHIC PROJECTS. F. J. Sette, *Proceedings, American Society of Civil Engineers*, March 1946. (Discusses in detail the planning, projecting, and estimating the cost of aerial photographic projects, and includes analyses of weather characteristics, flight conditions and schedules, and costs of materials, planes, salaries, etc.)

TERRESTRIAL PHOTOGRAMMETRY FOR SUPPLEMENTAL CONTROL. J. E. King, *Photogrammetric Engineering*, March 1946. (Describes a new camera transit, photo transit, and procedure designed to reduce the cost of supplemental control for terrestrial photogrammetry.)

PROCEEDINGS OF THE 12TH ANNUAL MEETING, AMERICAN SOCIETY OF PHOTOGRAMMETRY. *Photogrammetric Engineering*, March 1946. (Contains complete proceedings including papers and discussions.)

PRELIMINARY OBSERVATIONS ON GEOLOGICAL USE OF AERIAL PHOTOGRAPHS. Frank A. Melton, *Photogrammetric Engineering*, March 1946. (Excerpts from and discussions of an article of this name recently published in the Bulletin of the American Association of Petroleum Geologists.)

GERMAN PHOTOGRAMMETRY IN THE WAR. Gerald FitzGerald and Russell K. Bean, *Photogrammetric Engineering*, March 1946, and *The Canadian Surveyor*, April 1946. (A discussion of the achievements and new developments of the principal German experimenters during the war.)

PHOTOGRAMMETRY IN CHINA. Chih-Cho Wang, *Photogrammetric Engineering*, March 1946.

MODERN CALIFORNIA CARTOGRAPHY: AIDS FOR THE MAP COMPILER. H. F. Raup, *The Pacific Historical Review*, March 1946.

ONTARIO SURVEYS AND THE LAND SURVEYOR. W. F. Weaver, *Canadian Geographical Journal*, April 1946. (Discusses early mapping and land survey problems, and the evolution to present-day conditions and procedures.)

WAR CHARTS OF THE U. S. NAVY. G. S. Bryan, *The Military Engineer*, April 1946. (A summary of the work of the Hydrographic Office in the preparation of charts during the war.)

A SURVEYOR LOOKS AT PANAMA. Stephen Rose, *The Military Engineer*, April 1946. (Describes surveying and mapping in Panama under typical jungle conditions.)

GEOGRAPHIC NAMES. Edna Loveless, *The Canadian Surveyor*, April 1946. (Selection of colorful place names in Canada with their etymologies.)

EVOLUTION OF LAND RECORDS. (Part I: Some Early and Feudal Developments.) Ernest M. Dowson and V. L. O. Sheppard, *Empire Survey Review*, April 1946.

NATIONAL RESPONSIBILITY FOR RESEARCH. J. E. Graf, *Journal of the Washington Academy of Sciences*, April 15, 1946. (Address of the retiring president of the Washington Academy of Sciences.)

AMERICAN ROAD MAPS AND GUIDES. Walter W. Ristow, *The Scientific Monthly*, May 1946. (Describes the historical background and evolution of road maps and guides paralleling the growth of cycling and use of the automobile in the United States.)

WE SHOULD ANNEX 50,000,000 SQUARE MILES OF OCEAN. Harold F. Clark and George T. Renner, *The Saturday Evening Post*, May 4, 1946. (Describes the potential resources of the ocean and stresses the need for annexing extensive ocean territory by the United States.)

BOUNDARY AND JURISDICTIONAL PROBLEMS OF THE KENTUCKY–OHIO BORDER. Eugene O. Porter, *The Ohio State Archeological and Historical Quarterly*, April–June 1946.

CITY PLANNING, ZONING, AND HOUSING. H. Evert Kincaid, *Civil Engineering*, June 1946. (Describes the city plan for Chicago now evolving from the co-ordinated efforts of all departments of local government.)

SUCCESSOR TO THE SEXTANT. Harland Manchester, *Scientific American,* June 1946. (Describes Loran and how it is being used in guiding world traffic by air and water.)

CHARLES MASON AND JEREMIAH DIXON. Thomas D. Cope, *The Scientific Monthly,* June 1946. (A background sketch of the famous surveyors; describes in detail the surveys they conducted along the Mason and Dixon Line.)

OPERATION CROSSROADS. Philip C. Krueger, *The Military Engineer,* July 1946. (A description of the organization of Joint Task Force One and the preparations made for the atomic bomb tests.)

BOOKS AND PAMPHLETS

PACIFIC OCEAN HANDBOOK (Revised edition). Eliot G. Mears. *Stanford University, Calif.: Delkin.* 1944. 198 pages. $2.00. (A summary of the geography, oceanography, and meteorology of the Pacific Ocean.)

POSTWAR PLANNING CONFERENCE FOR CONTROLLED SURVEYING AND MAPPING. (Bulletin of the Agricultural and Mechanical College of Texas, No. 86.) *Texas Engineering Experiment Station,* College Station, Texas. 1945. 66 pages. Single copies free. (Includes eight papers discussing map projections, coordinate systems, aerial photographs in controlled mapping, geodetic control surveys, and highway planning.)

PLASTICS, SCIENTIFIC AND TECHNOLOGICAL. H. Ronald Fleck. *Chemical Publishing Company,* Brooklyn, N. Y. 1945. 325 pages. $6.50. (Plastics raw materials, their manufacture and chemical analysis are discussed; the applications of plastics in molded articles, surface coatings, fibers and textiles, and plywood are examined.)

WILEY TRIGONOMETRIC TABLES. *John Wiley & Sons, Inc.,* New York. 117 pages. Second edition. $1.00. (Ten trigonometric tables, to five places, including logarithmic tables, tables of powers and roots, S. and T. tables, frequently used constants, haversines, and mils.)

HOW TO BUILD TERRAIN MODELS. U. S. Navy, Office of Research and Inventions. (Prepared for U. S. Office of Education.) 28 pages. 1945.

GRAINED VINYLITE AND THE MEDINA–LOONEY PROCESS. U. S. Hydrographic Office. 9 pages. 1945.

HANDBOOK OF METEOROLOGY. Edited by Berry, Bollay, and Beers. *McGraw-Hill,* New York. 1946. 1,068 pages. $7.60. (A text reference for the beginner and for the professional meteorologist. Contains sections on numerical and graphical data, physics of atmospheric phenomena, scientific basis of modern meteorology, instruments, transmission and plotting of data, oceanography, and other subjects.)

RADAR ON WINGS. *Philco Corporation,* Philadelphia. 1946. 32 pages. (An illustrated booklet giving salient facts about the Corporation's development and production of airborne radar equipment.)

VINYLITE ELASTOMERIC COMPOUNDS. *Bakelite Corporation,* New York. 1946. 19 pages. (Illustrated booklet describing molding and extrusion compounds, flexible sheeting and film, and cloth coating compounds.)

TWO-WAY RADIO. Samuel Freedman. *Ziff-Davis,* Chicago-New York. 1946. 506 pages. $5.00. (Treats of two-way radio systems for communicating between a fixed station and a mobile unit or between two mobile units.)

RADAR: WHAT RADAR IS AND HOW IT WORKS. Orrin E. Dunlap, Jr. *Harper & Brothers,* New York. 1946. 208 pages. $2.60. (A popular version of the story of Radar without equations or technical language.)

NEW CITIES FOR OLD. Louis Justement. *McGraw-Hill Book Company,* New York. 1946. 232 pages. $4.50. (An analysis of political, financial, social, and legislative factors involved in the reconstruction and rehabilitation of urban areas.)

DISTINCTIVE RECENT MAPS

A place of high distinction among "distinctive recent maps" should be given to the maps contained in the "Ice Atlas of the Northern Hemisphere," published this year by the United States Hydrographic Office. This atlas contains 106 pages (24½ by 24½ inches) of colored charts, tables, and bibliographical data (1,700 references). A general section devoted to the Northern Hemisphere as a whole (north of latitude 30° North) is followed by special sections covering respectively the Grand Banks, the Baltic Sea, the Black Sea, and the Sea of Okhotsk and vicinity. With regard to marine conditions the charts show for each month the distribution of ice of various categories classified according to the degree to which it impedes navigation, and also its extreme limits. River conditions are represented by isopleths showing the average opening and closing dates and the average annual number of days when streams are closed.

Another interesting recent product of the Hydrographic Office is the "Strategic Plotting Chart—Arctic Regions," in six large sheets which encircle the earth between latitudes 59° and 75° North. This map is on the Mercator projection, with a scale of 1:2,188,800 at latitude 67° 30′ North. Drainage and names are printed in black, and in certain areas formlines are added in brown. The lack of information available to the compilers concerning Siberia is made apparent by the extensive blank spaces on the sheets covering that region and by the use, instead of formlines, of such terms as "Reported over 3,000 feet."

Convincing evidence that the German occupation did not call a halt to vigorous cartographical work in either the Netherlands or Denmark is provided by materials recently received at the American Geographical Society. These include a set of colored geologic maps, issued by the Rijks Geologische Dienst, on the scale of 1:50,000, covering nearly the whole of the Netherlands, and based on field surveys begun about 1930. The publications of the Danish Geodetisk Institut are even more impressive. Among them are sets of the handsome 1:200,000 and 1:100,000 maps of Denmark, and the 1:100,000 and 1:50,000 maps of Iceland (the last covering only the western part of the island). While many of these sheets date from before the German invasion, a large number appeared subsequently. Particularly tantalizing to the writer of these notes, who does not read Danish, are three sumptuous and obviously scholarly facsimile atlases of historical cartography published by the Institut during the occupation. The first, which appeared in three volumes in 1942 and is entitled "Johannes Mejers Kort Over Det Danske Rige," consists of superb reproductions in color of the detailed manuscript maps and plans of a Danish mapmaker of the mid-seventeenth century. The second, "Danmarks Kortlaegning: en Historisk Fremstilling," published in 1943, is a work in the tradition of A. E. Nordenskiöld's famous "Facsimile Atlas"; it consists of reproductions of maps of Denmark and vicinity from the time of Ptolemy to 1813, together with an introductory text. The third, "Faeroernes Kortlaegning: en Historisk Fremstilling," published in 1944, is a

similar work for the Faeroe Islands, comprising, however, reproductions not only of old maps but of the Institut's modern topographic maps on the scales of 1:20,000 and 1:100,000.

The Ordnance Survey has issued two new maps, using for the base its two-sheet outline map of Great Britain (1:625,000), mentioned in SURVEYING AND MAPPING for April 1945, page 52. One shows the population of urban administrative areas by means of red discs proportionate in area to the populations represented. The other, entitled "Land Classification," is like its companion maps of "Land Utilization" (1942) and "Types of Farming" (1944). By colors it differentiates ten different qualities of rural land ranging from "First Class Land" (level or gently undulating; deep, fertile, easily worked loams, silts, mild peats) to "Poorest Land" (shingle, sand, saltmarsh, etc.). The map brings out the vast areas of "Moorland and Rough Pasture" in Scotland, northern England, and Wales.

—JOHN K. WRIGHT

State Coordinate Systems Used in Highway Map

AN IMPORTANT DEVELOPMENT in highway mapping has been achieved in the production of the 1946–47 edition of the Official Highway Map of Maryland, published by the State Roads Commission. As far as is known this is the first such map to use the State Plane Coordinate Systems, devised by the U. S. Coast and Geodetic Survey, for referencing place names on a highway map, instead of the conventional Atlas Grid. The plane coordinate lines are indicated in red and are used for the full grid, while the geographic coordinates of latitude and longitude are indicated by marginal ticks. All places appearing on the map are identified by horizontal and vertical coordinates in an alphabetical listing of places. The coordinates of a place are given to the nearest thousand feet, which, at the scale of 8 miles to the inch, are accurate to about one-fortieth of an inch.

The new map shows the latest information regarding the State road system and county road connections. Important features, such as mileage distances and traffic markings, are shown by a red overprint. The location of State Police substations, hospitals, fire towers, and many other important features are also shown. Supplemental information shown in the margin includes "Rules of the Road" for the benefit of the motorist.

Excellent reproduction adds materially to the appearance of the map, on which the counties are emphasized by a pleasing series of color tones. The map, which is 40 by 20½ inches over-all, is furnished with accordion fold for convenient handling.

The plane coordinate system provides a greatly improved medium over the Atlas Grid. Names appearing on the map can be accurately spotted, whereas the Atlas Grid gives only approximate locations. Another advantage is that coordinates will apply to any map of the area, regardless of scale, upon which the State Plane Coordinate System has been projected.

"The best way to keep good acts in memory is to refresh them with new."

—CATO

Book Reviews

PRACTICAL AND THEORETICAL PHOTOGRAPHY. Julian M. Blair. *Pitman Publishing Corporation*, New York. Second Edition. 1945. 243 pages. $2.50.

Reviewed by Walter H. York, Chief of Photographic Laboratory, U. S. Geological Survey, Washington, D. C.

THIS BOOK is a condensed explanation of the principles of photography in non-technical language. It is evident that the author is a photographer. There are 30 chapters printed in good type containing a full range of topics, from cameras, through the photographic fundamentals, to aerial photography. The subjects are presented in lesson form.

The author has apparently designed the book to fill a need for an intermediate text, between very elementary and advanced technical photography.

Among those who will find this book of practical value are the hobbyists and those who have gained an understanding of the technique of photography and desire more information on the fundamental science of the subject. To them it is a practical and helpful book containing good basic information. The photographers who fall into this classification are very much interested today in motion pictures. They will be disappointed, for while there are chapters on photomicrographs, police photography, X-rays, and photo-engraving, no mention is made of motion picture equipment or its operation.

The advanced or professional photographer will find, in many chapters, undue attention given to elementary and irrelevant topics, while the treatment of the actual operations is inadequate. As an illustration, there are 19 pages devoted to the subject of lenses and 6 pages to aerial photography. A complete book could be written on either of these subjects, particularly aerial photography. Unfortunately for persons interested in mapping, 6 pages limits the author to only a brief summary of the subject of aerial photography.

PHOTOGRAPHIC SURVEYING. B. B. Talley and Paul H. Robbins. *Pitman Publishing Corporation*, New York. 1945. 232 pages. $3.00.

Reviewed by William S. Higginson, Photogrammetric Engineer, U. S. Geological Survey, Washington, D. C.

THE AUTHORS of Photographic Surveying have produced a very informative book on the elements of making maps from aerial photographs. It consists principally of a background of elemental and fundamental information concerning the photographs, instruments, and most of the accessories that are used by the photogrammetric engineer in the compilation of a map. While this information is given in clear, understandable language which is well adapted to a class in photogrammetry or for general information for the engineer engaged in compiling maps from aerial photographs, much information is omitted which is essential in the performance of a complete project in all the different phases of a photogrammetrist's work.

In chapter 2 the authors give a very clear description of the photograph and the elements of it which are used in a critical investigation of the component parts of the photograph. It would seem desirable to continue from this point on and give a complete exposition of the calibration of a photograph. Some very useful information in this connection is given concerning tilt and elevation displacements in a photograph. Computation of the

tilt angle of the photograph and analytical methods of control extension would also be extremely useful information for the student interested in this work.

The study given to terrestrial and oblique photography has been given a very important place in the book and the information given herein will be appreciated by anyone who works with this type of photography.

It seems evident that the experience of the authors has been in the field of radial line and stereocomparator map compilation, and the material throughout the book is rather unique in this method of mapping. Flight planning, scale determination, horizontal and vertical control, and photo-interpretation have been determined with respect to the above type of equipment. Several problems of importance in radial line map compilation, such as the area of each photograph to be used, photo-rectification, control, and others that are considered at length in this discussion, become non-essential in the more generally used types of stereo-plotting instruments of today. However, the brief descriptions of these instruments given in chapter 11 are very plainly written and form a sound base for a detailed investigation or further study of the stereo-plotting instruments most used in this country today.

The technique of making photo mosaics is more detailed and includes more practical information in this field than I have seen recorded in a single previous publication.

The multiple uses of the photograph as demonstrated by practical experience in the Tennessee Valley Authority, as well as many other organizations, have given the photograph a permanent berth in making physical surveys. As a science, photographic surveying should also become a part of engineering instruction.

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"THE ENGINEER AT LAW"

A two-volume work entitled "The Engineer at Law—A Resume of Modern Engineering Jurisprudence," jointly authored by the late Conde B. McCullough—formerly assistant state highway engineer of Oregon—and his lawyer son, John R. McCullough, has been issued under the sponsorship of the engineering and legal research program of the Oregon State Highway Commission. The book presents a bird's-eye view of the broad field of the law, contains a mine of information applying to engineering problems, and points out the pitfalls and necessity for expert consultation on specific problems.

Application for the book may be made to the Oregon State Highway Commission, Salem, Oregon, which has a limited supply for sale at cost of publication.—*Civil Engineering*, August 1946.

"PRELIMINARY SURVEY PROCEDURE"

This booklet, available without charge to all civil engineers, is published in the interests of greater efficiency and economy of time and labor in the making of preliminary surveys under all conditions. The author of this work, Raymond A. Hill, of the widely known firm of Quinton, Code and Hill, Consulting Engineers, explains in detail the practical use of the Paulin System Altimeter in connection with all branches of preliminary field surveying. Geologists, scientists, topographers, surveyors, and educators will find this book of interest and technical value.—*Civil Engineering*, October 1946.

The Map Information Office of the U. S. Geological Survey

By C. F. FUECHSEL*

MANY years ago the desirability of co-ordinating the surveying and mapping activities of the Federal Government was recognized. After World War I the Federal Board of Surveys and Maps was created by Executive Order upon the recommendation of the major map-using and map-making agencies, and, among other stipulations, this order directed the Board to ". . . establish a central information office in the Geological Survey for the purpose of collecting, classifying, and furnishing to the public information concerning all map and survey data available in the several government departments and from other sources. . . ."

This was quite an order, particularly in view of the limited allotments subsequently made available. However, the Board and the Map Information Office functioned within their authorized correlative and advisory capacities—as well as financial limitations—until the Board was abolished by Executive Order early in 1942. Its functions were assigned to the Bureau of the Budget, at whose request the Map Information Office has since been maintained by the Geological Survey—though in dormant status during the recent war.

It is generally recognized that a central and authoritative source of information pertaining to maps, surveys, and aerial photographs within the Federal Government is most necessary, and to that end the Geological Survey is greatly expanding its facilities. Opinions of those outside the Survey regarding the appropriate scope of such a set-up range from summary generalities—which could be maintained by a few specialists—to the most intensive research, record-keeping, evaluation, and distribution of the product—which would involve a bureau-sized structure of some hundreds of employees. In view of the current volume of bona-fide service requests, the reasonable facility for the immediate future—keeping practical limitations in mind—will involve from 20 to 30 employees. With an organization of this size, requirements anticipated during the coming year from our production units, other agencies, and the general public may be met. A constantly increasing volume of requests for information has been evident during the past few months, however, and it is likely that a year or so hence a considerably larger organization may be necessary.

Organization

The Map Information Office of the Geological Survey has now been established as a section of the Planning and Co-ordinating Staff of the Topographic Branch. Within the office four specialized units have been developed to cover their designated fields of responsibility, as follows: Topographic Maps, Aerial Photography, Geodetic Control, and General and Foreign Maps.

Presented at Sixth Annual Meeting, American Congress on Surveying and Mapping, Washington, D. C., June 28–29, 1946.

* Chief, Map Information Office, U. S. Geological Survey.

Topographic Maps Unit.—The prime responsibility of this unit is research for all topographic data pertaining to the United States and its possessions, which have been produced by any government or commercial organization.

It has become more and more evident in recent years that substantial savings in new mapping operations alone more than justify this initial investment of effort. The actual search must be followed by the systematic assembly and evaluation of all discovered data to facilitate their use. Present photogrammetric procedures require this assembly of data for the efficient performance of the whole sequence of mapping phases, namely, aerial photography, control planning and survey, stereo-plotting, field completion, and editing. This initial product of the mapping operation is, of course, made available to other agencies and to the general public in the same manner as the published end product—the topographic map.

Perhaps the most complex phase of this preparatory work is that of map evaluation which, as an initial step, involves the development of practicable criteria for determining map adequacy. Nearly half of the United States is topographically mapped in some manner, and a thorough-going classification of this information is needed for public use as well as for the planning of comprehensive projects and establishment of priorities for new mapping. The publication of a series of index maps showing various phases of the status of mapping is planned for the near future.

The appraisal of map *adequacy* is inevitably associated with map *accuracy* standards. However, the accuracy standards now employed apply to maps produced in very recent years, rather than to the older surveys, which were accomplished with lower cost and accuracy standards to meet the general requirements of earlier years. Yet such maps have a high utility value for certain present-day requirements. It therefore appears necessary to maintain a general index of map usability until the country is covered with relatively high-grade surveys, at which time the accuracy compliance records will suffice as an index of actual utility. The Geological Survey is now making an over-all study of the status of topographic mapping from the actual utility standpoint.

The Topographic Maps Unit, in addition to its research and evaluation work, maintains a complete file of all topographic maps produced by the Geological Survey together with their compilation histories. The maintenance of a bibliography of established and current literature dealing with standards, procedures, and other information related to topographic mapping, is also the assigned responsibility of this unit, as well as the ultimate preparation of a comprehensive map catalogue.

Aerial Photography Unit.—The primary responsibility of this unit is the assembly of complete information regarding the existing aerial photographic coverage of the United States and its possessions. Records of the coverage obtained by the Department of Agriculture and certain other federal agencies are already in good order, but much coverage obtained by state, city, and commercial organizations is now unrecorded at a central reference point.

In addition to recording information on available coverage, date of photography, and film-holding agency—which is our immediate objective—we hope to eventually maintain supplementary data such as flight altitude, focal length of lens, and information on mosaics and other by-products. Only summary generalities regarding the aerial photography available for foreign areas will be

maintained—sufficient, however, to service geologic and other special projects of the Survey which may arise in foreign areas.

Perhaps the largest potential work item of the Aerial Photography Unit is that of preparing copies of Survey photography to meet the requests of other agencies and the general public. While this is not a heavy obligation at the present time, the Survey's mapping coverage will be very greatly extended during the coming years; and substantial laboratory and film storage facilities will be required to meet these requirements.

Geodetic Control Unit.—The assembly of all horizontal and vertical control data which can be used in the preparation of topographic maps will be one of the responsibilities of this unit. The necessary coverage indexes and other records will be maintained to service our production units, and this information will be available to others for reference purposes. All data for control established by Geological Survey parties will be reproduced in quantity and distributed to the public by this unit. State indexes, showing the general locations of all existing horizontal and vertical control will also be maintained and, if demands justify, published for distribution.

General and Foreign Maps Unit.—Since the Library of Congress and Army Map Service already maintain extensive files and coverage records of foreign areas, only general summary data are maintained by this unit to facilitate reference to the appropriate holding agency. The "general" maps, however, including those other than topographic which pertain to the United States and possessions, are covered in detail to support Survey operations. Preliminary assemblies are made of data suitable for project planning, aerial photography, and control lay-outs. Other production units subsequently require the most authentic information pertaining to political boundaries, nomenclature, road classifications, and so forth, to facilitate compilation and editorial work.

Public requests for county, state, and regional maps covering a wide variety of special uses are now quite numerous. This indicates the desirability of maintaining a broad assembly and thorough classification of general coverage maps as an adjunct to the requirements of our own production groups.

The foregoing summary of functions covers the consensus regarding the scope of information and public service that should be available from federal sources at one central point. A survey of facilities maintained by the several federal agencies is now being made to determine existing gaps in over-all requirements and to plug such gaps by assembling the necessary data within the Map Information Office. In connection with this survey, coverage indexes and other pertinent data are being recorded in order that public requests for information may be accurately referred to the specific agency and unit holding the particular item of interest, when detailed information from the producing agency is required. By this means a satisfactory service may be rendered without building an organization of unreasonable size.

The Director of the Survey extends a cordial invitation to the surveying and mapping professions to make the greatest possible use of our Map Information Office.

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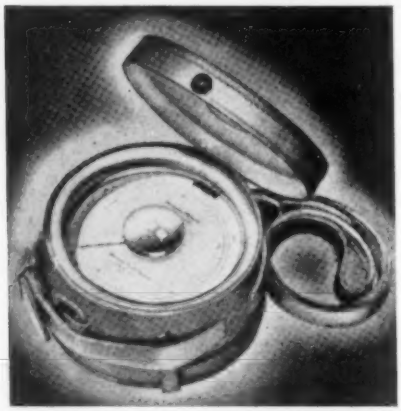
WHY NOT ENROLL ANOTHER NEW MEMBER IN THE CONGRESS?

New Instruments and Equipment

Surveying Altimeter

Great accuracy and sensitivity are claimed by the American Paulin System, Los Angeles, for the new "SA" series of surveying altimeters, made in several models to cover all



ranges of elevation above and below sea level. The instrument is rugged and comes encased in a leather carrying case with hand and shoulder straps, and weighs 2 pounds. In this device diaphragm movement is directly and without friction read in terms of inches, pressure, or feet altitude on the dial.—*Engineering News-Record*, September 5, 1946.

Sensitized Papers

Positive prints may be made direct from engineering drawings and tracings without the use of a negative, it is claimed, with the new Weiline sensitized papers, products of J. H. Weil & Company, Philadelphia. A dry-direct process of development, which uses no wet chemicals, quickly produces prints that are flat and true to scale.

Blue, red, or sepia prints are obtainable with these new papers; this choice of color (blue or red lines on white background) permits quick recognition of prints from different departments, and differentiates checked from unchecked prints. Sepia prints on Weiline transparentized papers may be used as intermediate originals, to save the draftsman's time in retracing when making design changes. A special Weiline eradicator removes obsolete lines and new ones may be drawn in with pen or pencil.—*Engineering News-Record*, April 4, 1946.

New Type Magnet

A new type of small, light, but powerful magnet made of iron rust and cobalt oxide has been developed by the General Electric Company. It has been used in highly sensitive aircraft meters and in other wartime devices, and now will be available for general civilian uses. It is made from an iron oxide ore in which the oxide is chemically the same as iron rust. It is claimed to be the lightest magnet ever developed.

The new type of magnet is a non-conductor of electricity and is not easly demagnetized. It thus may be used in high-frequency magnetic fields with little eddy current loss, it is claimed.—*Science News Letter*, January 5, 1946.

New Draftsman's Stencils

To speed production of the three-dimensional type drawings now widely used in many industries, two new sets of draftsman's stencils have recently been placed on the market. One set of stencils provides the correct axes for isometric drawings; the other set is designed for drawings with axes at dimetric angles.

Both sets incorporate edge graduations for scaling the work in hand, and each stencil has 27 ellipse openings, correctly projected and ranging from $\frac{1}{8}$ to 2 inches in diameter. The larger Hi-Range Instrumaster Stencils provide ellipses of greater diameter. All ellipse openings are marked as to the size of circle represented and carry centerlines for locating purposes.

The stencils, manufactured by Instrumaster Industries, are made of clear plastics stock 0.04 inch thick. Graduations and lettering are debossed on the lower surface.—*Scientific American*, June 1946.

Adjustable Quadrangle

An adjustable quadrangle combining many drafting features not usually available in one instrument has been announced. The new plastic drafting tool is called the S & J Quadrangle by its designers, the Stewart-Jackson Instrument Company, Los Angeles.

Angles from 0° to 90°, pitch scales from 0 to 24/12, percentage slopes from 0 to 100, and sine or cosine functions and tangents may be found with the S & J Quadrangle. This instrument has eight drawing edges, is rectangular in shape, 4 by 10 inches over-all, and may be used as a triangle.—*Civil Engineering*, July 1946.

MAP INFORMATION

This department was inaugurated in the January–March issue for the purpose of bringing to the attention of the members information pertaining to the availability of maps, surveys, etc., with particular emphasis on how such material can be procured. Authoritative articles covering this class of information are solicited. It is believed that through an interchange and dissemination of such information maximum benefits will accrue to the surveying and mapping profession. Comments and suggestions on this department will be welcomed. —EDITOR.

The Domestic War Mapping Project of the War Department

(See Coverage Map Enclosed)

By A. W. KENDALL
LIEUTENANT COLONEL, CORPS OF ENGINEERS (RESERVE)

"THE ENEMY is already broken and will never rise again." So spoke Hitler in referring to the Russians in the fall of 1941. His personal press chief echoed this thought with: "For all military purposes Soviet Russia is done with." In spite of the habitual exaggeration of the Nazi higher command, there were no apparent reasons at the time to doubt these statements. In Libia, Rommel's Afrika Korps was receiving steady reinforcements, casting a shadow of doubt over the ability of the British to stop the advance of the "Desert Fox." England, working feverishly to complete her defenses, depended on shipping from the New World to withstand an invasion of its homeland—and this shipping was being sunk by U-boats at the rate of 180,000 tons a month. It only remained for the Axis Powers to deliver the knock-out blow to Russia, invade England, and then strike the United States before this Nation could mobilize its manpower and resources for successful resistance.

In retrospect the thought of invasion may sound a bit fantastic, but the hard cold facts of the then current military situation motivated the War Department to direct the Chief of Engineers to mobilize all mapping agencies of the Federal Government, and private contractors who would participate, for the purpose of preparing large-scale military maps of strategic areas of the country. Needless to say, all agencies contacted were eager to co-operate.

Under this program, the Coast and Geodetic Survey mapped sizable areas in Virginia, Maryland, and North and South Carolina; in areas along the coasts of Maine, New Hampshire, Delaware, and New Jersey; the west coast of Florida; and in the Florida Keys. The Tennessee Valley Authority was responsible for the mapping of a large area in New York State, also areas in South Carolina and Texas. The Geological Survey did extensive mapping in the States of New York, Vermont, Maine, Massachusetts, New Hampshire, Connecticut, Rhode Island, Pennsylvania, Florida, California, and Oregon. The Soil Conservation Service

did work in the States of Virginia, Maryland, and Pennsylvania. The Forest Service mapped areas in California, Maryland, and Pennsylvania. The private mapping agencies, including Fairchild Aerial Surveys, Inc., Keystone Aeronautical Corporation, and Aero Service Corporation, mapped areas in Pennsylvania, New Jersey, New York, and California. The Corps of Engineers was responsible for the remainder of the areas mapped under the War Mapping Program.

This was purely a military operation, based on military necessity. In spite of careful planning, enthusiasm, hard work, and efficient operation by all concerned, the project did not accomplish its military objective. The inertia resulting from decades of apathy toward the provision of large-scale maps of our country could not be overcome in the short time available. Fortunately, due to the changed military situation, the maps resulting from the project were not required for their intended purpose. From the viewpoint of the civilian map user, however, the War Mapping Project did provide large-scale maps of areas which would not otherwise be mapped at the present time.

Where Maps may be Obtained

Most of the maps prepared under the War Mapping Project were published at a scale of 1:31,680. Maps of a few areas were prepared for publication at a scale of 1:62,500. The accompanying map indicates areas covered by the War Mapping Project and areas covered by other maps published by the Corps of Engineers which were prepared by topographic troops or civilian components of the Corps. By comparing the accompanying map with the map accompanying the article "Topographic Maps of the U. S. Geological Survey," in the April–May–June 1946 issue of Surveying and Mapping, it will be noted that a few areas appear to be covered by adequate maps of both the Survey and the Corps of Engineers. This does not mean there has been a duplication of mapping effort, but that by co-operative efforts of the two organizations, these areas are covered by "military" editions and "civil" editions of identical basic quadrangles.

With very few exceptions all maps published are available to the public at the same prices and conditions under which U. S. Geological Survey maps are available. At present the maps may be obtained directly from the Commanding Officer, Army Map Service, 6500 Brooks Lane, Washington 16, D. C. However, arrangements are under way to transfer the map stocks to the U. S. Geological Survey. When this transfer is completed, the public will have only one agency to contact in regard to information on or procurement of domestic topographic quadrangles.

Completion of Topographic Map Needed

The readers of this Journal are probably too familiar with the past slow rate in the progress of topographic mapping of the country to warrant much discussion of the matter. It is sufficient to say that we shall never know how much valuable time and money were lost and how many mistakes were made during the war through lack of adequate topographic maps. Sites for munitions plants, military highways, radar stations, and other war installations costing billions of dollars were determined without the aid of topographic maps in many cases. The development of strategic minerals and other resources was likewise hampered by this lack of maps. If we had been called on to face an invasion, it is impossible to say what the lack of maps would have cost in terms of lives and military success.

The Army has discussed the mapping of "strategic" areas to an extent where the impression has been erroneously created that the War Department is interested only in mapping limited areas. It is true that there is an over-riding military operational need for mapping of selected areas. However, the policy of the War Department is based on two assumptions: (1) that the country is strongest from a military standpoint whose natural resources are fully developed or are capable of rapid expansion and development, and (2) that such development can be accomplished only when adequate topographic maps of the entire nation are available.

In order to avoid the mistakes of the past, the War Department is making every effort to encourage the completion of the topographic mapping of the United States by federal agencies responsible for this work.

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New Geologic Map of Wyoming Area

A GEOLOGIC MAP of an area of about 1300 square miles in the southern part of the Wind River Basin and adjacent areas in central Wyoming has been issued by the U. S. Geological Survey. The map, which has been in administrative use in the Survey for many years, has been made available to the public because of the current interest in oil and gas possibilities in this part of Wyoming.

It is a westward extension of Preliminary Map 51 of the Geological Survey's Oil and Gas Investigations series, which was recently published. Like Map 51, it was originally prepared on the basis of field investigations made in 1913–1914 and has been published essentially in its original form. Subsequent changes in formation names are shown by a stratigraphic section that compares present usage with that prevailing at the time the map was made. Highways, county lines, and locations of oil and gas fields have been added.

Published on a single sheet measuring 28 by 32 inches and titled "Geologic Map of the Southern Part of the Wind River Basin and Adjacent Areas in Central Wyoming," it has been issued as Preliminary Map 60 of the Oil and Gas Investigations series. Copies may be purchased from the Director of the Geological Survey, Washington 25, D. C., at 30 cents each. Copies will be available also for over-the-counter sale at Geological Survey field offices at the Federal Building, Casper, Wyoming; at Room 314, Boston Building, 828 17th Street, Denver, Colo.; and at Room 234, Federal Building, Tulsa, Okla.—*Civil Engineering*, October 1946.

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BENEDICT MAY BECOME OCEAN PORT FOR NATION'S CAPITAL

Plans are being considered to convert the fishing village of Benedict, Maryland, into an ocean port for Washington, D. C. The Army Engineers have been authorized to make a survey of its possibilities.—*The Nautical Gazette*, September 1946.

Comment and Discussion

The pages of SURVEYING AND MAPPING are open to a free and temperate discussion of all matters pertaining to the interests of the CONGRESS. It is the purpose of this Department to encourage comments on published material or the presentation of new ideas in an informal way. —EDITOR.

"THE USE OF TYPOGRAPHY IN MAP MAKING"

EDITOR'S NOTE.—Because of recent inquiries regarding the details of the gluing machine mentioned in the article "The Use of Typography in Map Making" which appeared in the April–May–June 1946 issue of SURVEYING AND MAPPING, the following additional information has been prepared by the author.

JOSEPH C. TAYLOR.*—The machine used in making wax-coated transparencies is a standard 12-inch Pleger Gluing Machine, Model B, made by the John J. Pleger Co., Chicago, Illinois. The only changes necessary for converting it to use for waxing are the removal of the upper feed rollers and the ejector fingers.

The gluing machine consists of an electric heating element beneath the tank, a cylinder so mounted that it is partially submerged in the tank and rotated by an electric motor, and an adjustable rider roller turning in contact with the cylinder to squeeze the surplus adhesive from the cylinder. The adjusting of the tension of this rider roller gives adequate control of the amount of adhesive carried by the cylinder.

The operation of the converted machine is accomplished by pulling the transparency across the rotating cylinder in the opposite direction from which the cylinder is rotating.

The adhesive used is Flexowax Light "C," obtainable from the Glyco Products Company, Brooklyn, New York. This wax melts to a fluid state by placing in the tank of the gluing machine. After being applied to the transparency it "sets" in a few seconds. The transparencies should be slip-sheeted as they are waxed. For this purpose vegetable parchment paper is used to assure the easy removal of the slip sheet at any time.

PUBLICATION OF FOREIGN LANGUAGE ARTICLES

GEORGE H. HARDING.†—A recent issue of Photogrammetric Engineering has an innovation which I think merits study by the Publications Committee of the Congress. In that issue there is an original article in Portuguese with an English translation on the opposite page. It seems to me that one or more such foreign language articles might well be included in SURVEYING AND MAPPING and might go far to increase the appeal of the magazine to our members in Central and South America.

Further development along this line might be the securing of an associate

* Chief, Typography Section, U. S. Coast and Geodetic Survey.

† Research Professor of Civil Engineering, Ohio State University.

editor, located in Mexico or one of the South American countries, who is familiar with Portuguese, Spanish, and English, with the idea of publishing there, probably primarily in Spanish, a South American edition of the magazine.

This might be beneficial both in procuring technical articles from surveyors and mappers in Central and South America, and in making available to them, through translations, articles appearing in regular issues of SURVEYING AND MAPPING. I believe that the real growth of membership in the American Republics will be contingent upon the regular publication of a Spanish edition.

"SURVEYING AND MAPPING" REACTIONS

Congratulations on the enlarged and improved SURVEYING AND MAPPING. Each issue seems to be more useful to us than the last.

The note concerning purchase of aerial photographs from the Department of Agriculture fills a definite need for us, as a number of individuals have inquired about such photos.—WALTER W. RISTOW, Chief of the Map Division, The New York Public Library.

I wish to compliment you and the Congress on Surveying and Mapping for the fine journal that you are producing. Several of the articles are of real interest and the general appearance of the magazine is excellent.—MEREDITH F. BURRILL, Director, U. S. Board on Geographical Names.

We believe your Map Information Department to be most valuable to all map users interested in latest available maps. Your article on "Topographic Maps of the U. S. Geological Survey" with accompanying index map was especially timely. —WILLIAM R. BOOTHE, Kargl Aerial Surveys, Inc.

"The quarterly Journal of the Congress, SURVEYING AND MAPPING, is a brightly produced publication of which the July 1945 issue contained 80 pages and the October 1945 issue 68 pages. The October 1945 issue completed the fifth volume with four quarterly issues to a volume, and a complete index to Volumes I–V has recently been published as a supplement. The paging, however, is not consecutive throughout the volume but is separate for each issue, a rather inconvenient arrangement when a volume is bound.* In general, the main articles in SURVEYING AND MAPPING are shorter and less technical than the corresponding articles in journals like *The South African Survey Journal*, *The Canadian Surveyor*, and the *Empire Survey Review*, but this tends to make for greater appeal to the general and non-technical reader, and, combined with the greater number of pages, enables the contents to be more varied. One of the most useful features of the Journal is the list of current literature on survey and mapping subjects which appears in each issue and which gives the titles of papers and articles on survey work contained in various periodicals, as well as the titles of new books and the names of their publishers. In some cases a very short description of the subject or contents of the paper or book is given after the other particulars, and in others

* Consecutive paging was begun with the January–March 1946 issue.—ED.

new books are reviewed in the ordinary way. Since January 1945 each issue also contains short notes on "Distinctive Recent Maps," and, although they mainly describe maps of particular areas in the United States, these notes are not without interest to readers in other countries. Altogether, the Journal is of considerable interest to surveyors generally, and, even if the annual subscription for membership in the Congress conveyed no benefit beyond the regular reception of the Journal, this alone would make it worth while for most surveyors, including those not resident in the Continent of America."—J.C. in *Empire Survey Review.*

FROM A NEW MEMBER

ISIDORE GREENBERG.*—I read SURVEYING AND MAPPING from cover to cover with a great deal of interest. I find it chock full of the most valuable information. I find the sections on "Surveying and Mapping News" and "Map Information" very informative. In the latter section I would like to see information on Canadian and Latin American map producing agencies; in the future perhaps information on map production in the other continents.

In my opinion the Congress fills a great need and I would like to see it grow. I believe the potential membership has hardly been tapped. From reading the names of the new members I note that most of them are public officials in mapping agencies. Hardly do I see teachers, geologists, geographers, amateurs, etc. An appeal should be made for them by well placed advertisements and announcements. This need not be very expensive nor detract from the dignity of the Congress.

Another way to augment the funds of the Congress would be to publish books and pamphlets in the field of mapping. For example, I just received a free copy of "Map Collections in the District of Columbia," from the Information Office of the U. S. Geological Survey. I think it would be worthwhile to announce this publication since there are some still available. The same thing could be done for other large cities or for the country at large and sold by the Congress for a nominal sum. This would be of great assistance in cartographic research. I think also that a publication listing, periodically, in one publication the titles and sources of new maps would fill a longfelt need and pay financially.

* Instructor in physics and chemistry, Sampson College, Sampson, N. Y.

Correction

In the article "Second-Order Taping Through Use of Taping Bucks," which appeared in the April–June issue of SURVEYING AND MAPPING, equation (1) on page 106 should read as follows:

$$\text{Inclination correction} = -\frac{h^2}{2c} - \frac{h^4}{8c^3}$$

CONGRESS NEWS

Reports of Technical Divisions and Committees

(As Presented at Sixth Annual Meeting, June 28, 1946)

PROPERTY SURVEYS DIVISION

The principal activity of this Division during the past year has been the completion of the Standards of Practice. These have already been presented to you.

During the year, the first draft of the Standards was thoroughly discussed by the officers of the Division, and various points of difference were arbitrated to the final document. The final document received the unanimous vote of the officers on every point.

Your chairman is proud to be identified with these Standards and the officers who developed them. It is the opinion of your chairman that this document represents a sound and realistic set of standards, capable of general practical application, and of sufficiently high level to represent a proper professional level for achievement.

It is tentatively agreed that the primary activity of this Division for the coming year or years must be the education of the entire profession and allied professions, title companies, and owners to the knowledge and recognition of these Standards as the authoritative document governing the procedures of property surveys. To this end it will be necessary to develop proper committees throughout the various sections of the country who will accept this responsibility. It will be necessary to enlist the aid of a number of men throughout the country who have the welfare of the profession at heart and who have the necessary energy and missionary spirit to conduct this important work.

Your chairman is pleased to have had the privilege of heading this Division for the past two years, and takes this opportunity to thank all of his fellow Division officers and the officers of the Congress for their co-operation.

S. A. Bauer, *Chairman*

CONTROL SURVEYS DIVISION

The Control Surveys Division for good and obvious reasons has been inactive since the April 1942 meeting. The war brought heavy demands for all kinds of geodetic work in many areas, and it is fortunate that despite the heavy and very sudden calls, the geodetic agencies accomplished all urgent projects practically on time.

War research brought many improvements and innovations in the instruments and appliances used in connection with triangulation, leveling, and field astronomic work. The most notable is the determination of distance by electronic methods. From the report we had at this morning's session on shoran distance

determination, it seems clear that this method will produce results comparable to geodetic values and thus is now adaptable to geodetic determinations in some areas. Moreover, there is hardly any question that further improvement will be made by the time the method is actually applied to geodetic projects.

One field project of particular importance which may not have come to the attention of many who are interested is the extension of the North American datum of 1927 into Alaska in 1943. This was accomplished by carrying the triangulation from southeast Alaska at Skagway through Yukon Territory via Whitehorse and the Alcan Highway to interior Alaska near Fairbanks; thence other extensions were carried to the various points along the coast and the Aleutian Islands, so that geographic positions in practically all of Alaska, except the Arctic, are now on the North American datum of 1927. As a result, first-order triangulation now extends from Cape Prince of Wales on Bering Straits through Alaska, Canada, the United States, and Mexico to the southern end of the 98th meridian on the west coast of southern Mexico, a distance of approximately six thousand miles.

Some of you may not be aware of our close relations with the Latin American countries as regards surveying and mapping. In 1941 several co-operative projects in hydrographic and geodetic surveying and in map and chart compilation were organized by the Coast and Geodetic Survey under the sponsorship of the Department of State. These projects provide training programs for interested and qualified representatives of the Latin American countries who are eligible on application through their respective governments. More than 44 professional men representing nearly all of the countries to the south of us have taken advantage of these programs. As a result, our understanding on things of common interest is now much closer and more cordial than ever before.

Two consultations on cartography have been held during recent years and a third one is planned at Caracas, Venezuela in August of this year. These have been under the sponsorship of the Pan American Institute of Geography and History and its Commission on Cartography. Some 75 to 100 representatives of practically all of the American Republics attend these consultations. Through the opportunity thus afforded for discussions on all phases of cartography, there is no question but what a better understanding exists with regard to our various problems.

During the war years the Division has been inactive without any change of officers, and it is proposed that sometime in the near future, arrangements will be made for the election of new officers to the Division.

C. L. GARNER, *Chairman*

TOPOGRAPHIC MAPPING DIVISION

The Division of Topographic Mapping has been inactive during the past year. However, the chairman has assembled some general observations concerning the mapping situation as he has gleaned from reports and personal knowledge.

Never before in the history of the nation has the average citizen been as map conscious as today. This is evidenced by larger map sales and through the many inquiries received for map information of those areas that are as yet unmapped topographically. Not only that, but there is an ever increasing demand for larger-scale maps. It appears the 15-minute quadrangle unit is rapidly heading for the discard, with the 7.5-minute quadrangle taking its place as the most

serviceable map unit. The inevitable result is that past over-all mapping estimates, as for example the $37,200,000 figure prepared at the time the Temple Act was passed in 1925, are mere "chicken feed" compared to those being thought about at the present time. The present outlook is that new estimates for a mapping program extending over a period of 15 to 20 years may well be 20 times the 1925 estimate in order to provide for the most urgent civilian and military map needs.

The War Department has approved a 20-year program for the mapping of 1,620,000 square miles of territory in the States and Alaska, beginning with the mapping of 61,000 square miles in the States and 20,000 square miles in Alaska during the 1948 fiscal year. In addition, there is need for the mapping of 170 ROTC unit training areas during the same fiscal year. All of the mapping to be done in the States is for publication on the 1:25,000 scale and that in Alaska on the 1:50,000 scale.

In the Department of the Interior, the Geological Survey is planning a mapping schedule extending over a period of from 15 to 20 years to care for the most urgent mapping needs in the interior of the United States and Alaska, and integrated with the War Department's program. The Survey's schedule is contingent, however, upon the attitude of Congress on such matters. The Trimetrogon Unit in the Survey continues to co-operate with the Army Air Forces in compiling material for aeronautical charts, and with the Bureau of Reclamation in mapping areas that are under investigation for the development of reclamation projects in the Missouri River Basin. Also, extensive mapping is in progress in the Columbia River Basin at the request of the Corps of Engineers, and the Survey is continuing its co-operative mapping with 18 States and the Tennessee Valley Authority.

In the Department of Commerce, the Coast and Geodetic Survey is proceeding at an accelerated pace with its inshore hydrographic surveys and basic surveys of coastal areas, and is undertaking mapping projects on the northeast coast of Maine, at the entrance to Delaware Bay, in lower Chesapeake Bay, on the east coast of Florida, along the shores of the Columbia and Willamette Rivers in Oregon, on the northwest coast of Florida, and along the southern coast of the Alaskan Peninsula.

The Forest Service in the Department of Agriculture is conducting topographic mapping in the reserves under its jurisdiction to provide basic map information needed in their administration. The Cartographic Section of the Soil Conservation Service continues to supply basic map information to the soil conservation districts of the Service.

JOHN G. STAACK, *Chairman*

INTERIM COMMITTEE ON MUNICIPAL AND COUNTY ENGINEERING SURVEYS

It is apparent that within the coming year, the formation of a permanent Technical Division on Municipal and County Engineering Surveys is not only wise but inevitable. Although interest at the moment is confined to certain areas, this interest has been enthusiastic and seems to indicate that concentrated over-all effort on the part of those immediately concerned will bring about a substantial response.

The original idea in the formation of an Interim Committee was to have this group solicit not only membership in the Congress from those interested in municipal and county surveying, but also to invite those who were willing and able to prepare interesting and timely articles for publication in SURVEYING AND MAPPING. In this way it was hoped to bring about discussion, interest, and action.

The members of the Committee have undertaken these tasks, and have made some progress. An invitation has been extended to every city engineer in New England to join with us at this time, and we expect to continue this work throughout the country. Articles have been solicited from several sources and promises received for future dates. Some of the Committee have made concrete suggestions as to future plans and are at the moment compiling lists of proposed publication material. Letters, expressing interest, ideas, and suggestions have been received from some members of the Congress. Certain cities, which are already planning to undertake city-wide survey and mapping programs, have been in touch with us; and the services of the Committee in an advisory capacity have been placed at their disposal.

The formation of an active Technical Division within the Congress is not a step which should be taken lightly. The potential membership is very great and in order to capture and hold their interest and active participation, many problems must be discussed and settled. It is desirable that the following objectives be pursued during the coming months:

(1) Publicity and information should be disseminated about plans and progress of the Division through the medium of SURVEYING AND MAPPING and, in addition, every attempt should be made to reach potential members by news articles in other publications which have a wider circulation.

(2) A backlog of good technical papers should be built up for publication in SURVEYING AND MAPPING.

(3) Contact should be made with, and a personal invitation should be extended to, every city engineer to join and actively participate.

(4) Those who are now members of the Congress and whose work is in this field should consider it a personal obligation to assist in every way in this work and should voluntarily contribute either a technical paper, a news article, the names of potential members of his acquaintance, or his written expression of interest and ideas. Members and others interested should contact the Chairman at 1258 Noble Avenue, Bridgeport 8, Conn., in order that an accurate poll may be taken of those who desire to share and co-operate in the work of the Division.

JOSEPH M. DEARBORN, *Chairman*

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NEW MEMBERS LIST

The October–December issue of SURVEYING AND MAPPING will contain a Membership Roster of all names heretofore published, through and including the April–June issue. In order that the names of all members to date might be contained in one issue of the Journal, the list of New Members that would normally be published in the present issue will be included in the next issue.

Congress Adopts United Nations Resolution

The following Resolution was unanimously adopted by the Congress at the Sixth Annual Meeting, June 28, 1946.

RESOLUTION ON CARTOGRAPHIC STAFF UNIT AND INTERNATIONAL CO-ORDINATING AGENCY

WHEREAS, One of the objectives of the American Congress on Surveying and Mapping is to provide a much needed means or channel for the exchange of information, advancement of techniques, establishment of standards, improvement of the professional status of those engaged in the work, and the exercise of international, national, and local expression on all matters concerning the general and scientific development of surveying and mapping, and

WHEREAS, A broadly representative group of surveying and mapping authorities, both federal and professional, have met and considered at length the advantages of the establishment within the framework of the United Nations both a cartographic staff unit and an international co-ordinating agency with commission or similar status, and have met and drawn up a memoranda setting forth these proposals, and

WHEREAS, The implementation of the above described proposals will result in expediting the solution of the urgent need of world-wide cartographic information, in accordance with established and accepted standards, be it therefore

RESOLVED, That the American Congress on Surveying and Mapping whole-heartedly endorses this action and memoranda and recommends to the United Nations that these proposals be implemented at the earliest possible moment.

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Obituary

ALTHEOD TREMBLAY, vice president of Tremblay and Dion, Inc., and director of the Corporation of Surveyor-Geometricians of the Province of Quebec, died at his home in Quebec on March 1, 1946 after a long illness.

Born at Montreal, November 25, 1877, Prof. Tremblay studied under the Freres Maristes and received his early training under surveyor J. P. B. Casgrain. He became surveyor-geometrician of the Province of Quebec at the age of 24, his first project being the construction of the Soulanges Canal. In 1906 he became associated with the Engineering Institute of Canada and, a short time later, became a member of the Corporation of Professional Engineers of Quebec. Later he was engaged to teach at Laval University and subsequently received the title of titular professor.

From 1919 to 1927 he drew up plans for Quebec and its suburbs, a project connected with the geodetic network of Canada. He founded the firm of Tremblay and Dion in 1929. He was a corresponding member of numerous scientific societies, both American and Canadian, and was a member of the American Congress on Surveying and Mapping.

"L'Action Catholique" of Quebec had this to say of Prof. Tremblay: "The professional competence of the deceased had become no less proverbial than his integrity and precision, which, although occasionally vexing his employees, nevertheless provided an example of perfect professional conscience which all willingly recognized."

He is survived by his wife, a son, an adopted daughter, four sisters, and two brothers.

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APPING

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